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(54) Title: TRANSPORT MULTIPLEXER MANAGEMENT AND CONTROL

(57) Abstract: A feature-rich transport multiplexer and a number of associated methods, systems, subsystems, software features, graphical user interfaces and control systems are disclosed. The disclosure includes GUI's that enable operators to easily monitor and manipulate content streams flowing through a transport multiplexer in real time. The disclosed interfaces include screens that supply operators with identity, structure, configuration, bandwith utilization and/or status information for system hardware and software. The disclosed features also provide computer assisted routing configuration for present and future routing envents through simple manipulation, such as drag and drop operations, of graphical objects. Routing control is further simplified by permitting operators to configure routing control of individual content stream components as well as groups of such components simultaneously. Further flexibility is permitted by predetermination of future routing events, thereby enabling the automatic execution of configuration changes at a future time. Various types of content, such as video, audio, IP data can be manipulated to achieve various results such as one or more multiplexed MPEG data streams.

TRANSPORT MULTIPLEXER MANAGEMENT AND CONTROL

CROSS REFERENCE TO RELATED CASES

[0001] This application claims the benefit under 35 U.S.C. 119(e) of co-pending U.S. Provisional Application Nos. 60/285,188 filed April 20, 2001 and entitled "Broadband Bandwidth Management, Device Management and Multi-Media Control System"; and 60/285,153 filed April 20, 2001 and entitled "Data Insertion, Transport, Grooming, Aliasing, Routing, and Multiplexing of MPEG 2 Data Streams", which Provisional Applications are hereby incorporated by reference.

[0002] This application is related to co-pending U.S. Patent Application Serial No. __/___,___, filed April 16, 2002 (based on provisional application no. 60/322,063 filed September 13, 2001) and entitled "High Speed Serial Data Transport Between Communications Hardware Modules," which Application is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0003] The present invention is directed to systems, processes, methodologies, apparatus and related software to manage and control broadband communications hardware. More particularly, the invention relates to improved up management and control of content streams routed through a broadband media router. Accordingly, the general objects of the invention are to provide novel systems, methods, apparatus and software of such character.

2. Description of the Related Art

[0004] Broadband media convergence between video, audio and data in recent years has created a chaotic environment of different standards and legacy communications technologies. Nonetheless, the relationship between physical and logical resources in such systems needs to be manipulated and communicated between broadband hardware, its control system and its operators. This has, in the past, been accomplished with a complex of dedicated management and control computers, each of which was responsible for administration of a specific piece of communications hardware. While modern communications hardware personnel, such as cable operators and television programmers, have used such systems in the past, such systems use great numbers of diverse equipment to control the system. These control systems have been centrally located in close proximity to each other and to the communications hardware being managed. For these and other reasons, conventional solutions to the need for control and management of broadband communications hardware have proven to be cumbersome, inflexible, inefficient and expensive to purchase and operate.

[0005] An additional problem with conventional broadband communications hardware is their inability to conveniently provide operators with information regarding the system hardware and software. This creates many inefficiencies in operation of such equipment. For example, troubleshooting system errors is currently a difficult and expensive process because system operators must physically inspect the broadband communications hardware in order to determine the system hardware utilized and its operational status. In particular, troubleshooting system difficulties may entail operator inspections of a communications hardware rack to determine if all of the communications hardware has been plugged-in, turned on, connected to the desire content streams and/or operated in a particular way.

[0006] There is, accordingly, a need in the art for novel methods, systems and apparatus that enable communications hardware personnel, such as cable operators and television programmers, to manage and control complete broadband media router systems with a single computer. Such methods and apparatus should be capable of remotely

monitoring and controlling such systems over a network. Ideally, control would be achieved with java-based system that could be uploaded to a remote personal computer using a browser during a set-up phase and subsequently run on the remote computer as a java program. In order to provide maximum flexibility at minimal cost, such a system would communicate via the network using a common browser and a widely recognized communications protocol such as SNMP.

[0007] There is a further a need in the art for novel methods, systems and apparatus that can provide operators with information regarding system hardware and software. Such methods and apparatus facilitate troubleshooting of system errors by avoiding the need to physically inspect broadband communications hardware in order to determine the system hardware utilized and its operational status. Indeed, such methods and apparatus of managing and controlling communications hardware should be capable of providing highly stable control over broadband media routers so that such troubleshooting can be minimized, if not eliminated altogether.

SUMMARY OF THE INVENTION

[0008] The present invention satisfies the above-stated needs and overcomes the above-stated and other deficiencies of the related art by providing methods, systems and apparatus that enable communications hardware personnel to manage and control complete broadband media router systems with a single computer. Such methods and apparatus in accordance with the invention are capable of remotely monitoring and controlling such systems over a communications network such as an Ethernet network. Management of a broadband media router, is preferably achieved with a java-based system that has been uploaded to a remote personal computer via the network during a set-up phase and then run on the remote computer in order to remotely manage the hardware. To provide maximum flexibility at minimal cost, the invention communicates via the network in accordance with a robust, flexible and widely recognized communications protocol such as SNMP.

[0009] Other aspects of the invention are directed to particularly stable methods of controlling certain aspects of normal system operations (such as enabling a port) to thereby minimize, if not entirely eliminate system instability and, by extension, system failure and troubleshooting. The invention achieves this result by practicing stable hardware enable and disable sequences.

[0010] In the event that system failure does occur for some reason, the invention facilitates troubleshooting of system errors by avoiding the need to physically inspect the managed hardware in order to identify the various hardware utilized, to determine their connectivity and to determine the operational status of each component. This advantage obtained through the use of system hardware and software identity, configuration and status viewing capabilities enabled by information retrieval via the network. The invention also provides an extensive array of log messaging features that further facilitate system troubleshooting and monitoring.

[0011] Naturally, the above-described methods of the invention are particularly well adapted for use with the above-described apparatus of the invention. Similarly, the apparatus of the invention are well suited to perform the inventive methods described above.

[0012] Numerous other advantages and features of the present invention will become apparent to those of ordinary skill in the art from the following detailed description of the preferred embodiments, from the claims and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The preferred embodiments of the present invention will hereinafter be described in conjunction with the appended drawing figures, wherein like numerals denote like elements, and wherein:

[0014] Figure 1a illustrates the hardware architecture of a transport multiplexer in accordance with one preferred embodiment of the present invention;

[0015] Figure 1b illustrates a preferred form of the firmware host processor architecture of the transport multiplexer of Figure 1a;

[0016] Figure 2 illustrates system initialization and resource discovery processes for the transport multiplexer of Figure 1, the processes being in accordance with one preferred embodiment of the present invention;

[0017] Figure 3 illustrates various system hardware attribute viewing capabilities in accordance with one preferred embodiment of the present invention;

[0018] Figure 4 illustrates system attribute viewing capabilities in accordance with one preferred embodiment of the present invention;

[0019] Figure 5 illustrates various output port enabling processes in accordance with one preferred embodiment of the present invention;

[0020] Figure 6 illustrates specification of present video and/or audio stream routing event(s) in accordance with one preferred embodiment of the present invention;

[0021] Figure 7 illustrates various system bandwidth utilization viewing capabilities in accordance with one preferred embodiment of the present invention;

[0022] Figure 8 illustrates certain event logging and viewing capabilities and processes in accordance with one preferred embodiment of the present invention;

[0023] Figure 9 illustrates specification of future content stream routing event(s) in accordance with one preferred embodiment of the present invention;

[0024] Figure 10 illustrates various IP data encapsulation and insertion capabilities in accordance with one preferred embodiment of the present invention; and

[0025] Figure 11 is a detailed flow chart illustrating the IP data encapsulation and insertion capabilities of Figure 10 in greater detail.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] The ensuing detailed description provides preferred exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the invention. Rather, the ensuing detailed description of the preferred exemplary embodiments will provide those skilled in the art with an enabling description for implementing a preferred exemplary embodiment of the invention. It being understood that various changes may be made in the functional arrangement of elements without departing from the spirit and scope of the invention as set forth in the appended claims.

[0027] As shown in Figures 1a and 1b, TMX 20 includes a plurality of hardware, firmware and software components. Figure 1a is a hardware architecture diagram showing a representative transport multiplexer (TMX) 20 in accordance with one preferred embodiment of the present invention. As shown therein, the transport multiplexer can include, for example, a computer 22' (with an element manager 22 and a GUI 80) that is communicatively linked to a TMX chassis 42 via a network 24. TMX chassis 42 preferably includes a host processor board 40' (preferably with a VxWorks operating system), an input processor board 50', and output processor board 55', a multiplexer board 60' and a transcoding board 70'. These components are preferably, but not necessarily communicatively linked to one another with a single TMX chassis 42. The basic physical model of the preferred TMX chassis hardware is as follows: the TMX chassis is a container for boards, each board is a container for ports and processors, each processor is a container for firmware, and each port is a container for a protocol hierarchy (i.e., DS3, MPEG, TCP/IP, etc.). The chassis and each board have a set of state and status variables associated with them. These include: 1) an administrative state which is used to synchronize configuration access of multiple managers; 2) an operational state which is used to indicate whether or not the TMX (or a component of it) is in a fully enabled and operational state; and 3) an alarm status which is used to signal a variety of

alarm conditions by the TMX or a component thereof. As described in detail below, the host processor 40 controls the various hardware and software components of TMX 20 and stores MIB table data in accordance with SNMP for use by the various other components of the TMX and the element manager.

[0028] Transport multiplexer 20 is suited to a wide variety of application environments including: (1) cable headend; (2) satellite uplink; and (3) terrestrial broadcast. Communication between element manager 22 and TMX chassis 42 is preferably performed in accordance with a modified Simple Network Management Protocol (SNMP) and the content streams to be routed through transport multiplexer 20 are preferably in accordance with one of the well-known MPEG standards. Most preferably, the content streams are MPEG2 data streams. While some preferred embodiments of the present invention use some conventional MIB tables in accordance with well known SNMP standards, many of the MIB's referenced herein comprise novel data structures. These data structures are fully defined in the computer program provided at the end of this specification. Therefore, those of ordinary skill will more than amply understand the nature and function of those novel data structures based on the teachings contained herein.

[0029] A more detailed description of the hardware components of TMX 20 is provided in previously mentioned co-pending U.S. Patent Application, Serial No. __/___,___, filed April 16, 2002 and entitled "High Speed Serial Data Transport Between Communications Hardware Modules," which Application has been incorporated herein by reference. Accordingly, further detailed discussion of these hardware components is not necessary, a complete understanding of these components being achieved with reference to these incorporated applications.

[0030] The relationship between physical and logical resources in the system needs to be manipulated and communicated between TMX chassis 42, element manager 22 and human operators 10 (e.g., Figure 2). This is generally achieved by modeling the various hardware components of the system. The TMX modeling elements are integrated

into the SNMP Management Information Base (MIBs) by using the standard "MIB 2" interfaces table (ifTable) to represent each one of the modeling elements as an interface with specific extensions as specified below. This permits identification of any board and/or any port, by its table index: the ifindex in the ifTable.

[0031] With continuing reference to Figure 1a, element manager 22 is preferably linked to TMX chassis 42 by an Ethernet. It will be appreciated by those skilled in the art that other network technologies can alternatively be used. Element manager 22 may be uploaded as a java-application from TMX 42 to a remote computer using a browser, the remote computer preferably being communicatively linked to transport multiplexer 20 via network 24 during an initial set-up phase. Subsequently, element manager 22 can be run on the remote computer as a java program. The remote computer is preferably a conventional personal computer with a conventional operating system and browser, the system permitting control over TMX chassis 42 subsequent to installation of element manager 22. A graphical user interface (GUI) is preferably incorporated into element manager 22 and is described in detail below. The GUI is preferably presented to an operator on a conventional personal computer monitor (e.g., an LCD screen or a CRT monitor). A wide variety of alternative software and hardware components for hosting and operating graphical user interface and element manager 22 will readily occur to those of ordinary skill in the art based on the disclosure contained herein

[0032] Figure 1b illustrates various firmware and software components 52-69 of TMX 20 which are communicatively linked to one another as shown therein. These components include an SNMP agent 44, a message handler 45 and a fault manager 59. TMX 20 further comprises a resource manager 52, a configuration manager 46, a PAT/PMT collection module 54, a PSIP collection module 57, an input module 50, an IP encapsulation module 66, a time table manager 67 and a number of DSP API's. These include multiplexer processing 60, transcode processing 62 and quantization level processing 64. There is a one-to-one correspondence between these firmware modules

and certain hardware components of the preferred embodiment. The corresponding hardware components can be found in Figure 1a and include input processor board 50', multiplexer board 60' (with a multiplex processor 60 and a quantization level processor 61), a transcoding board 70' (with either 5 transcode processors 71 or 3 transcode processors, 1 multiplex processor and 1 QLP 71'). Consequently, when the configuration manager performs operations on the firmware modules, the corresponding hardware modules are also affected. The flow of information and commands between the various components within TMX chassis 42 is generally indicated in Figures 1a and 1b by the use of arrows. In particular, the flow of commands and information from element manager 22 is through SNMP agent 44, which translates SNMP protocol commands from element manager 22 into a conventional form so that they can be understood by the various other components of TMX 20. The preferred conventional communication protocol is a simple protocol in which a number indicative of a request or command is passed along with an associated data structure for receiving data to be manipulated in accordance with the associated command. Thus, SNMP agent 44 generally acts as a communication broker between element manager 22 and the host processor firmware. SNMP agent 44 allows SNMP based management of and control over firmware functionality such as grooming, splicing, data insertion, etc., because it provides an interface with the various firmware modules (e.g., input processing task 50, multiplexer processing 60, transcode processing 62 and quantization level processing 64) that ultimately provide the desired functionality.

[0033] Configuration manager 46 receives commands and information from SNMP agent 44 via MIB message handler 45 and determines how to utilize the hardware and other firmware to execute those commands at the card level. A detailed understanding of the various other components of TMX 20 will be obtained with reference to Figures 2 through 9 and the corresponding detailed description of these figures in the remainder of this specification.

[0034] Figures 2 through 11 illustrate the nine primary operational aspects of transport multiplexer 20. These nine operational aspects include (1) initialization and

discovery of system resources 100; (2) view system hardware attributes 134; (3) view system software attributes 156; (4) enable output port 166; (5) specify present video and/or audio routing event(s) 184; (6) view bandwidth utilization 206; (7) view log activity 222; (8) specify future routing event(s) 238; and (9) IP data encapsulation and insertion 260. These aspects of the present invention are discussed in detail immediately below.

[0035] With reference to Figure 2, there is illustrated therein system initialization and resource discovery processes for the broadband multiplexer of Figure 1, the processes being in accordance with one preferred embodiment of the present invention. As shown, initialization and discovery of the inventive system commences with power-up 101 of TMX chassis 42, whereupon resource manager 52 conducts discovery (at 102) of the hardware and system software information. Thus, TMX chassis 42 executes a number of functions at 104 to identify system components installed in TMX chassis 42. Also at 102, MIB message handler 45 populates the appropriate MIB's (ifTable and ifStack) with information and SNMP agent 44 awaits queries at 106. Upon completion of these tasks, TMX chassis 42 is prepared to execute various activities based on operator-driven commands delivered to TMX chassis 42 via element manager 22.

[0036] At this point, an operator 10 can start up element manager 22 in response to which the element manager, at 104, displays graphical user interface 80 showing a blank tree view screen 81 for viewing. Blank tree view screen 81 includes an input tree window 82, an output tree window 82' and a log message window 87. At 108, element manager 22 automatically reads the appropriate MIB's to discover the hardware that is currently installed in TMX 20. This includes system hardware attribute data such as port data and/or physical structure. There are several types of ports (e.g., ASI, DHEI, SMPTE 310, DS3) which are supported by the preferred embodiment of the present invention. Data for various port parameters is described /defined by the ifentry MIB table. At 110, element manager 22 downloads the appropriate DSP code to the IdentxTable MIB. SNMP agent 44 of TMX chassis 42 creates a new MIB entry at 112

and message handler 45 passes this information to configuration manager 46 for fulfillment. At this point, element manager 22 requests PAT data at 114. This request is processed by the TMX at 116. At 120, the PAT is parsed by element manager 22 so that the appropriate PMT's can be identified. These are requested at 122 and this request is processed by the TMX at 124. After the requested information is generated, SNMP agent 44, awaits further queries at 126. This data is then read by element manager 22 at 128 and graphical user interface 80 is updated. In particular, the requested data is used to populate tree view screen 81 with system hardware icons 84 and 84' and, preferably mnemonic, hardware names 83 and 83' extracted from the data streams themselves using PSIP collection module 57. Operator 10 is, thus, presented with a visual representation of the system hardware components.

[0037] After receiving the system hardware attributes data from TMX chassis 42, element manager 22 proceeds to retrieve and display log messages that may have been generated at 130. This is achieved with the assistance of a fault manager 59 and SNMP agent 44 at 132. Thus, once log polling has commenced, element manager 22 displays the port and log data at 132 to graphical user interface 80 where the tree view screen is updated to display input ports 85, output ports 85' and log messages 88 in log message window 87. As shown, input and output ports 85 and 85' preferably have associated mnemonic and alphanumeric identifiers. The ports are also preferably color coded to indicate whether or not the ports are active. Upon reviewing the newly completed tree view screen 81, operator 10 can initiate various activities as described below with respect to Figures 3 through 10. These activities can include, for example, view system hardware attributes 134, view system software attributes 156, enable output port 166, specify present video and/or audio routing events 184, view bandwidth utilization 206, view log activity 222, specify future routing events 238 and IP data encapsulation and insertion event(s) 260. Various other related activities that can be performed by operator 10 will readily occur to those of ordinary skill in the art based on the disclosure contained herein.

[0038] Turning now to Figure 3, this Figure illustrates various system hardware attribute viewing processes 134 in accordance with one preferred embodiment of the present invention. The hardware processes shown in Figure 3 are initiated by operator 10 upon selection of the chassis view screen from the menu items at the top of tree view screen 81. This option is accessed by selecting the "view" menu item at the top of the screen and selecting the chassis view option. Available hardware viewing options include "front chassis view" and "rear chassis view" and "system information." Upon selection of one of the chassis view options at the graphical user interface, element manager 22 gathers the requested hardware information from the appropriate MIB's (136) with the assistance of TMX chassis 42. This MIB data is provided by TMX chassis 42 as indicated by 138 and element manager 22 then displays the information on one of chassis view screen 89 and 90.

[0039] With continuing reference to Figure 3, one can see that graphical user interface 80 uses the received hardware and status data to display system hardware attributes and, in particular, chassis view screens 89 and 90 as initially requested by operator 10. Front chassis view screen 89 includes various graphical objects indicative of the identity of, physical structure of, configuration of and status of the various cards received within TMX chassis 42. In this illustrative example, these cards include CPU card 40", multiplexer card 60", first input processor board 50" and second input processor board 50'". While it is also possible to receive log messages within log message window 87 of front chassis view screen 89, no log messages have been generated in this illustrative example.

[0040] Rear chassis view screen 90 can also be selected by operator 10 as an alternative to front chassis view screen 89. In this illustrative example, rear chassis view screen 90 includes various graphical objects indicative of the identity of, physical structure of, configuration of and status of the rear portion of the various cards received within TMX chassis 42 and discussed above with respect to the front chassis view. The log messages can, optionally, also be displayed in log message window 87 of rear chassis

view screen 90. This aspect of the present invention allows an operator 10 to easily select, and then, view system hardware attributes in the manner discussed above. This feature of the present invention is particularly advantageous in that it allows an operator to troubleshoot difficulties with transport multiplexer 20 without having to physically access the communications hardware itself.

[0041] The preferred continuous hardware status polling features of the present invention are shown at 139. In particular, the LED status information provided in the chassis view screens is updated at regular intervals by the repeated execution of the functions shown in blocks 140 – 146.

[0042] Turing now to Figure 4, this figure illustrates system attribute viewing processes and capabilities 156 in accordance with one preferred embodiment of the present invention. As shown therein, viewing of system attributes such as board type, DSP attributes, software version, etc. commences with the initial system discovery process when the TMX executes the functions shown at 158. Thus, this information is readily available for display and SNMP agent 160 waits for such queries at 160. Upon selection of the version view menu option within the top portion of tree view screen 81 by operator 10, element manager 22 gathers the requested information at 162 displays it in system attributes screen 91. The data can then be viewed by operator 10 as desired. As shown in Figure 4 and Table 1 below, system attributes data displayed on screen 91 preferably includes the following data fields for the board and software running on each chassis slot:

Table 1
Board Name
TMX Application
JVM Version
System Name
IP Address
Chassis ID
Board Revision
FPGA Version
VxWorks 08
CPU Version
MAP Lib Version
MUX Version
QLP Version
TPE Version

[0043] In the illustrative embodiment of Figure 4, TMX chassis 42 is a mid-plane TMX chassis with five board slots in each half of the chassis. Accordingly, this illustrative example includes ten slots (five slots for each half-plane). A detailed description of the structure and operation of TMX chassis 42 is contained in the application incorporated by reference and a wide variety of variant arrangements will readily occur to those of skill in the art based on the disclosure contained herein.

[0044] As shown in Figures 3 and 4, the preferred embodiment of the present system includes a GUI with a system information tab with which an operator can access information about the system such as system name, system description, system up-time and system location. This feature of present invention operates in a manner that is generally analogous to the view software version feature shown in Figure 4 and described in connection therewith immediately above

[0045] Figure 5 illustrates various output port enabling capabilities in accordance with one preferred embodiment of the present invention. As shown therein, output port enabling is initiated upon selection by operator 10 of the particular port to be enabled. Upon selection of a port, element manager 22, at 168, displays the transport editor 92 with default values. Operator 10 can then view the default data and edit the data if desired, such as by changing the status from disabled to enabled. For example, an operator will typically enable a transport stream, name that stream and assign an information transfer bit rate for the selected port. Upon selection of the "OK" button, the transport editor is closed, and element manager 22 gathers transport information from the editor and places it in the appropriate MIB tables (see 170). The TMX chassis also uses this information to execute the enable request as indicated at 172. The MIB table could be either one of two types: TMXiftable (for most ports) or the TMXgiexttable (for DS3 ports) due to the varying information requirements of the different port types.

[0046] Further, element manager 22 creates a PAT at 174 and the PAT is output by the TMX as indicated at 176. Finally, the tree view screen 81 of the GUI is updated by the element manager as indicated at 178. Graphical user interface 80 indicates successful enablement of the desired port by changing the attributes of the port icons in tree view screen 81. This is preferably accomplished by changing the color of the port icons, but other alternatives (such as changes in shape, movement, location, size, sound, etc.) will readily occur to those of ordinary skill in the art. Operator 10 can, thus, visually confirm that port enablement was successfully completed by viewing the newly-updated graphical user interface 80.

[0047] Figure 6 illustrates various system-assisted video and/or audio routing capabilities in accordance with one preferred embodiment of the present invention. As described in greater detail below, the present invention enables operator 10 to define and execute content stream routing either manually or semi-automatically. In particular, the preferred embodiment of the present invention provides operators with the ability to manually enter routing data element by element or, alternatively, to drag and

drop graphical objects to and from various locations of the tree view screen 81. Element manager 22 cooperates with graphical user interface 80 to execute the various routing specification commands specified by corresponding drag and drop operations. This is achieved with automated population of MIB tables corresponding to the various actual fields necessary to define a routing command. Drag and drop operations on graphical user interface 80 assist operator 10 in defining video, audio and/or IP data routing events for the system. Defining routing specifications in this way is, therefore, semi-automatic.

[0048] Drag and drop operations on the graphical user interface can be used to perform a variety of related content stream routing functions. These include the ability to drag different levels from the input tree to the output tree. For example, an operator may drag (1) the content streams of an entire input port (possibly including plural programs, each of which possibly includes plural components) to an output port; (2) a complete program of an input port to an output port; (3) a complete program from an input port to a program of an output port; and (4) a component from an input port to an output port. A number of other drag and drop features will readily occur to those of ordinary skill in the art based on the disclosure contained herein. However, it should be noted that this portion of the specification specifically addresses content stream routing that occurs in the present. The invention, however, also envisions configuration of content stream routing to be automatically executed at a future time (see, e.g., Figure 9). As described in greater detail below, content stream routing processes described immediately below (applicable to execution of present routing commands) are compatible with, and form a portion of, routing processes for execution of routing events in the future.

[0049] With primary reference to Figure 6, operator 10 can specify one or more present routing events by selecting the graphical objects representing one or more content streams to be routed to a desired location (e.g., an output port). The content stream could be either simple or contain plural components which may or may not be related to one another in one or more ways. For example, the object may represent a single component content stream, plural content steams that collectively constitute a

program, or plural content steams that collectively constitute data streams present on an entire input port. In the illustrative example discussed immediately below, operator 10 drags the content streams for an entire port from the input tree to the output tree and proceeds to edit video and audio components of one program from the port.

[0050] Assisted routing in accordance with the invention is preferably accomplished with a drag and drop operation of one or more graphical objects from the input port window 82 to the output port window 82' of tree view screen 81. This operation has the effect of capturing, as indicated at 186, configuration data corresponding to the selected source of the data stream(s). For example, dragging and dropping the desired graphical objects enables element manager 22 to automatically capture corresponding configuration data for the desired routing events such as input port number and location, output port number and location, content stream PID to be routed and bit rate for the content streams to be routed. Additionally, information regarding the targeted output port (determined based on where the object is dropped) is also captured (188) by element manager 22 and includes, for example, the location of the targeted output port. This information enables element manager 22 to create default settings and to automatically perform PID aliasing at 186 so that there are no data stream conflicts as the various streams are routed through transport multiplexer 20. The drag & drop editors 93 and 94 are then displayed by element manager 22 as indicated at 188. The operator can then select the particular component to be edited and, at 192, element manager 22 receives the selection and displays a component editor (95 for video streams or 95' for audio streams) with default information for possible editing. If the default data shown in the component editor 95 is acceptable to the operator, the "OK" button can be selected to cue the element manager to take further action. In particular, closing of the component editor window causes element manager 22 to gather the information from the GUI and to request the creation of various MIB table entries as shown at 194. The TMX executes the routing events in accordance with the updated MIB's at 196 and the GUI is appropriately updated by the element manager 22 as indicated at 198. From the operator's perspective,

routing has been specified and performed simply by dragging and dropping an icon from the input tree to an output tree. In actuality, a variety of routing parameters have been specified with the assistance of the system as described in detail above.

[0051] If operator 10 wishes to modify the default and/or captured data, operator 10 has the ability to edit the information in detail for each of the components that comprise the content stream. In the example shown, operator 10 has selected program 1 (in general, an operator would select some type of graphical object, such as an icon or its associated text) shown in editor window 93 and a more detailed editor window 94 is displayed, the window showing the constituent components of the selected program. In the case of Figure 6, program 1 has been selected for editing and it includes one video component and one audio component.

[0052] Graphical user interface 80 preferably has the capability of identifying content streams using a variety of graphical objects which include icons, alphanumeric character strings, actual program names, etc. on the various screens. The content stream identification data is preferably carried within the media stream so that it can be consistently displayed throughout the graphical user interface regardless of which viewing screen is presented to operator 10. Restated, graphical user interface 80 preferably presents a consistent content stream name or symbol and can display it throughout the interface.

[0053] With continuing reference to Figure 6, selection of the "OK" button of window 94 closes the drag and drop window and opens the component editor windows corresponding to the selected components as indicated at 192. In this case, selection of a component to be edited further results in display of one of component editor windows 95 and 95' where operator 10 has the further ability to specify details such as bit rate, target PID, etc. for any of the components of the desired program. In this case, video editor window 95 and audio editor 95' are displayed for consideration and possible editing. This feature enables a user to more easily allocate bandwidth among the various content streams being routed so that maximum bandwidth utilization can be achieved.

[0054] Upon selection of the "OK" button of one of windows 95 or 95', the element manager 22 changes the MIB table data in accordance with the edited changes and instructs the TMX to execute the specified routing configuration. Configuration manager 46 then sequentially configures the targeted multiplexer and quantization level processor and enables the input processor, in that order, as indicated at 196.

[0055] The module activation order, when an output port is enabled, is an important aspect of the present invention. In order to effectively execute a routing event, the targeted multiplexer, quantization level processor and input processor should be activated in the order specified to minimize the possibility of the destabilizing the system. In particular, configuration manager 46 directs the targeted multiplexer to collect the designated PIDs and route them to the targeted output. Second, the configuration manager 46 must provide the quantization level processor 64 with the appropriate bit rate and PMT for the content stream to be routed. Third, configuration manager 46 should instruct the input processor to send all of the content streams with a particular PID to the multiplexer. This is preferably accomplished by performing PID aliasing and then sending the associated data to the multiplexer as a low voltage differential signal.

[0056] As noted above, module activation in an order other than that discussed above may lead to system instability. If, for example, the configuration manager attempted to enable the input processor first, the multiplexer may begin to receive a content stream that it does not expect and this confusion may cause the multiplexer to crash. Similarly, removing a content stream (ceasing to route the stream to the port) should be performed in a predetermined order dictated by configuration manager 46. In particular, the sequence noted above should be reversed (deactivation of the input processor, deactivation of the QLP and, finally, deactivation of the multiplexer). If, for example, the multiplexer were disabled first, the multiplexer may still receive a content stream from the input processor and, once again, this condition may crash the multiplexer.

[0057] Turning now to Figure 7, this figure illustrates various system bandwidth utilization viewing capabilities in accordance with one preferred embodiment

of the present invention. As shown therein, operator 10 initiates the view bandwidth utilization feature of the invention by selecting the bandwidth manager menu item from the upper portion of tree view screen 81. This enables element manager 22 to display the bandwidth manager screen at 208 and the TMX begins polling the system for bandwidth utilization data and waiting for queries for this data as shown at 210 – 212. As indicated more fully in the accompanying computer program, the MIB tables enable monitoring of MPEG input/output bandwidth utilization information. In particular, the TMXinputPIDtable is used for input rate monitoring per PID. The TMXoutputPIDtable is used for output rate monitoring per PID.

[0058] In particular, message handler 45 begins polling input processor and output multiplexers for data that is used to update the MIB tables (capturing data from these two sources allows the bandwidth display to show a comparison between the input bandwidth and output bandwidth) and sends the data as SNMP data to element manager 22, as indicated at 214. Element manager 22 periodically queries the TMX for this information and at 216 displays this data on graphical user interface 80. It then returns to continue polling for new bandwidth utilization data at 214. In this way, bandwidth utilization data for all enabled ports is continually updated and can be displayed by graphical user interface 80 in real-time. Bandwidth data polling preferably ceases when operator 10 closes the bandwidth windows 96 and 96' such as by switching to the chassis or tree view screens. At that point, the PID's for the enabled content streams are deleted from the MIB tables.

[0059] Upon receipt of bandwidth utilization data, graphical user interface 80 displays a bandwidth utilization screen 96. This screen preferably includes automatically rescaling x and y axes and an individual graphical object for each content stream being routed, each object preferably being a bandwidth bar (bars 97, 97'and 97" in the example shown). Each bandwidth bar shown in screen 96 preferably includes the following plural attributes: an output bandwidth utilization value 97a, an input bandwidth utilization value 97b, a maximum input bandwidth utilization value 97c and minimum input bandwidth

utilization value 97d. In practice, changes in the bandwidth utilization are automatically displayed in bandwidth utilization screen 96 in real-time.

[0060] Bandwidth utilization screen 96 can include a number of user-friendly features to make the graphical user interface even more intuitive and useful. For example, operator 10 may be provided with the ability to select or deselect a legend display shown on the right hand portion of bandwidth utilization screen 96. Similarly, operator 10 preferably has the ability to select or deselect display of the minimum and maximum bandwidth utilization values. Furthermore, screen 96 preferably has the ability to display the same mnemonic identifiers for the various streams that are used in other screens such as the tree view screen. Restated, the graphical user interface preferably reflects a consistent identifier for each content stream throughout the system. Naturally, other identifiers could be used if desired. These identifiers are preferably sent with the content streams so that they can be detected and displayed in various screens. As noted above, the identifiers may be displayed as colored icons and/or alphanumeric character strings, etc.

[0061] After viewing bandwidth utilization screen 96, operator 10 may select one of the bandwidth bars to dynamically display more detailed information about the various components that make up the content stream for the selected bar. For example, a given program might include one video and two audio components. Selecting a bandwidth bar will cause detailed bandwidth utilization window 96' (with additional information about these components) to appear on the screen. This type of selection causes element manager 22 to generate a query at 216 which is responded to by the TMX at 210/212. As shown in window 96', the program name, the group ID and the total bandwidth at the instant that the bandwidth bar was taken are captured and displayed on the screen. In this illustrative embodiment, the bandwidth bar for program 2 was selected when the bandwidth utilization was about five megabits per second (compare windows 96 and 96' of Figure 7). Additionally, the detailed window breaks the selected program down

into its constituent components. In this case the program has three constituent parts: IP data 1, video data 1 and audio data 1.

[0062] The screen 96' shows even more detailed information for each component of the program. This information preferably includes a bandwidth minima value, a bandwidth maxima value and the instantaneous bandwidth utilization of the constituent components at the instant the detailed bandwidth utilization window was selected. With joint reference to screens 96 and 96', it will be appreciated that the displayed bandwidth utilization of the constituent components sums to the bandwidth utilization of the entire program. Additionally, the sum of the minimum values of the constituent components equals the minimum value for the program as a whole. Similarly, the maximum value for the entire program equals the sum of the minimum values for each of the constituent components. Finally, the display shows the packet identifier PID associated with the program.

[0063] Since this aspect of the system displays bandwidth in real-time, the operator will see the bandwidth utilization varying over time. Also, differences in bandwidth utilization at different points in time will reflect the fact that input signals can vary over time on the input side of the whole system. For example, if an input signal suddenly includes an additional component, the bandwidth display screen will reflect that change in real-time.

[0064] Figure 8 illustrates various event logging and viewing capabilities 222 in accordance with one preferred embodiment of the present invention. As shown therein, the system has the ability to filter the log messages displayed on the graphical user interface. Viewing log information in accordance with the present invention initially entails operator selection of an appropriate log filter level, thereby placing the system into one of four modes. The filter level is recorded by the element manager 22 and the number and type of messages displayed in the log message window 87 of graphical user interface 80 is dictated by the filter level. The desired log filter level can be selected from the "view" drop down menu item near the top of tree view screen 81 and then selecting the

log messages option. There are preferably four filter levels: normal status, emergency status, fault status and debug. In debug mode all of the generated log messages are displayed.

[0065] Upon startup, the TMX chassis 42 the status query task begins to poll the system to thereby generate log messages that are used to populate the TMXLogPortTable, as shown at 224. The SNMP agent 44 then waits to respond to for queries for this information as shown at 226. This log messages can be generated by any one of the various firmware modules and element manager 22, GUI 80 and TMX chassis 42 cooperate to continually pass log messages in accordance with the previously selected log level to the graphical user interface for display in the scrolling log message window. Additionally, these log messages are stored for possible retrieval and analysis in the future. Although the log messages presented to an operator in normal use can be filtered, all log messages generated by the system are preferably stored on the element manager's host computer. One separate log file is preferably generated for each day the system is in use and operator 10 has the ability to retrieve and view log messages for any given day in the log file archive screen 98.

[0066] Upon selection of the Log File Menu by operator 10, element manager 22 retrieves, displays and stores log files as indicated at 228. This screen is accessed by selecting the "view" menu item near the top of the tree view screen 81 and by then selecting the appropriate option. Upon selection of one of the daily log files from the list of log files in the archive screen 98, individual log messages from the selected log file are displayed for viewing on screen 98' as indicated at 230. When reviewing stored log messages, the operator also has the ability to filter the information by selecting one of the four filter levels as discussed above.

[0067] Figure 9 illustrates various future content stream routing capabilities 238 in accordance with one preferred embodiment of the present invention. Specification of future event(s) is initially driven by operator action on the tree view screen. In particular, upon initialization and discovery of the system, the system initially sets up one

routing event that spans the current time up to a predetermined time in the future (e.g., two years). This is shown in a time bar 99. Operator 10 can then select time bar 99, as shown in the upper right hand portion of tree view screen 81. The resulting pop-up menu allows operator 10 to either modify the displayed current event or to create a new event. In the case of specifying the future routing events, operator 10 would create a new event by selecting the create new event option and by specifying start and stop times for the new event. At that point, indicated at 240, another duplicate event (by default) is created by element manager 22. This information is then sent to the graphical user interface 80 for display and possible modification as shown at 241. The particular editor that is presented to operator 10 depends on what type of event will be created. In the representative example of Figure 9, audio and video editors 95 and 95' are presented. IP data streams could also be specified for a future routing event as will readily occur to those of ordinary skill based on the teachings contained herein. Once all of the various details for the various components of the future event has been completed, this information will be gathered by the element manager at 242 and displayed on screen 81'. As shown on screen 81', three events have been define in the illustrative example of Figure 9. At 244, element manager 22 requests that new entries be added to certain MIB's and TMX chassis 42 executes the configuration changes at 246. Also, element manager 22 updates the GUI at 252. This results in a tree view screen 81" that is substantially similar to that of screen 81', but that displays the routing trees according to the newly executed configuration.

[0068] Preferably, none of this future event configuration data is provided to TMX chassis 42 until shortly prior to the predetermined time for commencement of the newly defined future event. Then (e.g., about 30 seconds prior to the predetermined time), the entire configuration data is sent to TMX chassis 42 for execution. This routing event data is slightly different from that discussed above with respect to Figure 6, in that it also includes predetermined time data indicating when the new routing configuration is to occur. In this way operator 10 can configure the system to automatically change

configuration routing control at future predetermined points in time, even in the absence of the operator. Thus, the system permits automated control of the inventive broadband media hardware by predetermining routing configuration information for extended time periods and enabling automatic execution of such configuration changes.

[0069] Figure 10 illustrates various IP data encapsulation and insertion capabilities and processes 260 in accordance with one preferred embodiment of the present invention. As described in greater detail below, the present invention enables operator 10 to define and execute IP data encapsulation either manually or semi-automatically.

[0070] In particular, the preferred embodiment of the present invention provides operators with the ability to manually enter IP encapsulation configuration data element by element or, alternatively, to automatically enter IP encapsulation configuration data by dragging and dropping graphical objects to and from various locations of the tree view screen 81. Element manager 22 cooperates with graphical user interface 80 to execute the various routing commands specified by corresponding drag and drop operations. This is achieved with automated population of MIB tables corresponding to the various fields necessary to define a routing command. Drag and drop operations on graphical user interface 80 assist operator 10 in defining IP encapsulation specifications for the system in a manner substantially analogous to the semi-automatic definition of video and audio routing events shown and described with reference to Figure 6. Those of ordinary skill in the art will readily appreciate how to extend these concepts to implement drag and drop procedures in order to achieve semi-automated IP data encapsulation based on the teachings of this specification. Manual, or element by element, IP data encapsulation techniques are described immediately below with respect to Figures 10 and 11.

[0071] With primary reference to Figure 10, operator 10 can specify one or more IP data encapsulation events 260 by selecting the graphical objects representing a desired location (e.g., an enabled output port) from a tree view screen 262. Operator 10

can then select a particular program into which encapsulated IP data will be inserted. This enables element manager 22 to capture configuration data relating to the targeted output port and any programs that may be resident thereon at 264. In the representative example of Figure 10, program 1 has been selected for insertion of an IP data component. Responsive to operator selection of program 1, element manager 22 (at 266) displays a program editor 270 and sends default output port values from the to the graphical user interface for display. Operator 10 can then enter various values relating to a program into which an IP data component will be inserted with the assistance of element manager 22 at 272. General and detailed IP data component editors 274 will then be displayed so that a variety of other parameters can be specified by operator 10. Operator 10 has the ability to edit the add/remove/change detailed information in the IP data components editors for each of the components that comprise the content stream. In particular, operator 10 has the ability to specify details such as source and destination IP addresses, bit rate, target PID, etc. for each component of the selected program in the general and detailed editor windows 274. This feature enables a user to more easily allocate bandwidth among the various IP data streams being created so that maximum bandwidth utilization can be achieved. Up to 128 IP data streams may be simultaneously specified for encapsulation and insertion in this way.

[0072] Upon selection of the "OK" button of one of windows 274, element manager 22 executes a number of functions at 276. In particular, element manager 22 gathers the edited information from the GUI and requests that various new entries be placed into certain MIB tables with default and/or edited data (as shown at 276). Element manager 22 also provides this information to TMX 42 for execution as shown at 278 of Figure 10 and in Figure 11. In particular, at 278, SNMP agent 44 creates the new MIB entries, message handler 45 passes the information to configuration manager 46 which configures one or more multiplexers and instructs the IP encapsulation module 66 to begin collecting IP data. IP encapsulation module 66 then receives IP data from the specified source IP address, encapsulates each IP data packet as one or more MPEG

packets, to thereby form MPEG data streams, and sends them to the targeted multiplexer(s). The targeted multiplexer(s) receives the assembled MPEG data packets and stream the MPEG data appropriately. At 280, the element manager updates the graphical user interface 80 which displays the updated information on tree view screen 289. Operator 10 can then view an IP data icon 290 that indicates encapsulation and insertion of IP data is occurring.

[0073] The portion of block 278 that performs the IP encapsulation process is illustrated in detail in Figure 11. As shown therein, upon execution of IP encapsulation process 282, the encapsulation module 66 instructs IP data stack (of the operating system running on the host processor) to collect/receive and examine an IP data packet at 292. At 293 the module 66 then verifies that the system is prepared to process IP packets (e.g., the target multiplexer(s) has/have been properly configured). The destination IP address for the received IP data packet is then tested for validity at 294. In particular, the destination IP address is checked to determine whether it is the broadcast, unicast or multicast IP address. This is preferably accomplished by verifying that the destination address is within the multicast range and that the address has been specified for data collection/reception. If the IP address indicates that the IP packet is not a multicast packet, the determination is made that the IP data packet must be either a broadcast or unicast packet. If so, the data packet is passed through the operating system (OS) stack in a conventional manner and the process passes to 296 where it simply waits to receive the next IP data packet. In particular, the preferred OS (VxWorks) employs a standard seven-layer OSI compliant IP stack that processes each broadcast and/or unicast packet to determine its type and the application that it should process it. Thus, for example, a broadcast packet that is found to be an ARP request would be sent to the ARP task for processing.

[0074] Conversely, if the source IP address indicates that the IP data packet is a multicast IP packet, the packet cannot simply be routed through the OS stack because the OS will not recognize the data packet except in the unlikely event that it is the

intended recipient of the packet. Thus, if the IP address indicates that the data packet is a multicast packet and if that address is one of the 128 addresses that element manage 22 has indicated as being associated with IP data that is to be encapsulated, the IP data will be converted to a different form and routed without going through the IP stack as an IP data packet. To achieve this, the process first passes to 297 where the IP data packet is fragmented, if necessary, into smaller content components for processing. The process then passes to 298 where an MPEG data packet is assembled and sent to the appropriate multiplexer(s). In particular, a 4 byte MPEG header that includes the target PID for this packet is created at 300. Then, at 302 the destination IP address is extracted from the IP data packet and used to create a 16 byte DSM-CC (Data Storage Media Command and Control) header for the first MPEG data packet. A conventional 4 byte Cyclic Redundancy Code (CRC or CRC32) MPEG suffix is preferably also included in the last MPEG packet (e.g., following the last byte of content). Since the system can support output data in either one of DVB or ASTC data formats, the DSM-CC header also indicates which format the output data is in to thereby account for the differences between these formats. At 304, up to 168 bytes of content are added to the MPEG 188 byte packet being created. If this can hold all of the content to be sent, then a CRC is appended after the last byte of content. At 308, a determination is made whether any fill data is needed to complete the MPEG packet. If so, process 282 passes to 310 where the remainder of the MPEG packet is filled with dummy data. This data is preferably the numerical value of 255 (FF in hexadecimal) and is repeated until a complete 188 byte MPEG data packet has been formed. With this system of the preferred embodiment, a maximum of one IP data packet will be inserted into a single MPEG packet. If no fill is needed (or after the packet has been filled), the process passes to 312 where the assembled packet is sent to the targeted multiplexer and it is preferably stored in a FIFO for combination with additional MPEG packets, if any. Also, the process passes to 314 where is it is determined whether or not the received IP data packet has been fully encapsulated. If so, the process passes to 316 where the multiplexer receives an

indication of how many MPEG data packets it has received together with an indication that this/these packet(s) should be transmitted. The process 282 then passes to 296 where the IP encapsulation module waits for the next IP data packet to be encapsulated.

[0075] If it is determined at 314 that the IP data packet has not been fully encapsulated, process 282 passes to 318 where additional content from the IP data packets are assembled into MPEG data packets and sent to the appropriate multiplexer. In particular, process 282 passes from 314 to 320 where an MPEG header for the next MPEG data packet is created. Up to 184 bytes of IP data and CRC (for the last MPEG packet) are then added to the packet at 322 and, at 326, a determination is made whether any fill data is needed to complete the MPEG packet. If so, process 282 passes to 328 where the remainder of the MPEG packet is filled with dummy data. This data is also preferably the numerical value of 255 (FF in hexadecimal) and is repeated until a complete 188 byte MPEG data packet has been formed. If no fill is needed (or after the packet has been filled), process 282 passes to 330 where the assembled packet is sent to the targeted multiplexer and it is preferably stored in a FIFO for combination with all prior and subsequent assembled MPEG packets, if any. Also, the process passes to 332 where is it is determined whether or not the received IP data packet has been fully encapsulated. If not, steps 320 through 332 are repeated until the entire IP data packet has been encapsulated and, eventually, the process passes to 316 and 296 as noted immediately below. If so, the multiplexer receives an indication of how many MPEG data packets it has received together with an indication that these packets should be transmitted at 316. The process then passes to 296 where the IP encapsulation module waits for the next multicast IP data packet to be encapsulated. Process 282 terminates when operator 10 specifies a different function for the subject output port or when the time period for the specified event has expired. At that point, IP encapsulation module 66 awaits further instructions from configuration manager 46.

[0076] The following computer program listing sets forth the TMX-MIB definitions referred to above:

```
TMX-MIB DEFINITIONS ::= BEGIN
       IMPORTS
       NetworkAddress, IpAddress, Gauge, TimeTicks
                     FROM RFC1155-SMI
              RowStatus,DisplayString,DateAndTime,TEXTUAL-CONVENTION
                     FROM SNMPv2-TC
              MODULE-COMPLIANCE, OBJECT-GROUP
                     FROM SNMPv2-CONF
              ifIndex
                     FROM RFC1213-MIB
              Counter32,Integer32,OBJECT-TYPE,MODULE-IDENTITY FROM SNMPv2-SMI
              bmr FROM NLS-BBNIDENT-MIB;

       tmxMIB MODULE-IDENTITY
        LAST-UPDATED     "0112202341Z"
              ORGANIZATION "Motorola BCS"
              CONTACT-INFO "John Sanders, Ext 3505 4A31"
              DESCRIPTION
                           "TMX MIB Version 1.1a"
              REVISION              "0008141355Z"
              DESCRIPTION
                           ""
              ::=  {  bmr  1  }

       ActionTriggerType ::= TEXTUAL-CONVENTION
              STATUS current
              DESCRIPTION
                     "Type of trigger mechanism for execution of
                     an operation"
              SYNTAX BITS {
                     operationCreation(0),
                     activationTime(1),
                     spliceImmediateFlag(2)
                     }

       org    OBJECT IDENTIFIER
              ::=  {  iso  3  }

       dod    OBJECT IDENTIFIER
              ::=  {  org  6  }

       internet      OBJECT IDENTIFIER
              ::=  {  dod  1  }

       private       OBJECT IDENTIFIER
              ::=  {  internet  4  }

       enterprises   OBJECT IDENTIFIER
              ::=  {  private  1  }

       tmxMIBObjects OBJECT IDENTIFIER
              ::=  {  tmxMIB  1  }

       tmxMIBConformance OBJECT IDENTIFIER
              ::=  {  tmxMIB  2  }
```

```
        tmxMediaInterfaces OBJECT IDENTIFIER
                ::=  {  tmxMIBObjects  1  }

        tmxMediaControl     OBJECT IDENTIFIER
                ::=  {  tmxMIBObjects  2  }

        tmxMediaMonitor     OBJECT IDENTIFIER
                ::=  {  tmxMIBObjects  3  }

-- TMX specific extensions to the MIB 2 Interfaces Table

        tmxNetTable                 OBJECT-TYPE
                SYNTAX              SEQUENCE  OF  TmxNetEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        " This is the network table associating TMX interfaces
(ifIndex)
                          with other types of equipment."
                ::=  { tmxMediaInterfaces  1 }

        tmxNetEntry                 OBJECT-TYPE
                SYNTAX              TmxNetEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION         "tmxNetTable entry"
                INDEX           { ifIndex, tmxNetIndex     }
                ::=  { tmxNetTable 1 }

        TmxNetEntry  ::=  SEQUENCE {
                tmxNetIndex                  Integer32,
                tmxNetEqpType                     BITS,
                tmxNetEqpName                     DisplayString,
                tmxNetEqpIpAddress                IpAddress,
                tmxNetEqpOperationalState  Integer32,
                tmxNetEqpAlarmStatus              Integer32,
                tmxNetEqpHeartBeatMonitor  IpAddress,
                tmxNetEqpRedundancyGroup   DisplayString,
                tmxNetEqpBackUp                           IpAddress,
                tmxNetEntryStatus                 RowStatus
                }


        tmxNetIndex                 OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                              "Identifier index for this networked equipment."
                ::=  {  tmxNetEntry  1  }


        tmxNetEqpType       OBJECT-TYPE
                SYNTAX              BITS { se1000(0), se2000(1), tmx(2),
```

```
                                        dataServer(3), adServer(4),
computer(5)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Type of equipment adjacent on ifIndex interface."
            ::=  {  tmxNetEntry  2  }


      tmxNetEqpName       OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Unique user assigned name to the physical
equipment."
            ::=  {  tmxNetEntry  3  }


      tmxNetEqpIpAddress  OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "IP Address of the adjacent equipment."
            ::=  {  tmxNetEntry  4  }


      tmxNetEqpOperationalState  OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "OperationalState of this networked equipment."
            ::=  {  tmxNetEntry  5  }


      tmxNetEqpAlarmStatus             OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "AlarmStatus of this networked equipment."
            ::=  {  tmxNetEntry  6  }


      tmxNetEqpHeartBeatMonitor  OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Heart beat monitor for this networked equipment."
            ::=  {  tmxNetEntry  7  }


      tmxNetEqpRedundancyGroup   OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
```

```
            STATUS              current
            DESCRIPTION
                        "Unique name of the redundancy group of this
networked equipment."
            ::=  {  tmxNetEntry  8  }


      tmxNetEqpBackUp           OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "IP Address of the back up of this networked
equipment."
            ::=  {  tmxNetEntry  9  }


      tmxNetEntryStatus   OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Status of this entry."
            ::=  {  tmxNetEntry  10  }

-- tmxMediaControl consists of tables used to configure the TMX media control
-- functionality.

      tmxOpNum                  OBJECT-TYPE
            SYNTAX              INTEGER
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "The number of last Op created."
            ::=  {  tmxMediaControl  1  }

      tmxToaLock            OBJECT-TYPE
            SYNTAX              BITS { unlock(0), lock(1)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "The number of last Op created."
            ::=  {  tmxMediaControl  2  }

      tmxToaLockTime          OBJECT-TYPE
            SYNTAX              INTEGER
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "The time (in second) to wait before starts executing
the unlock operation"
            ::=  {  tmxMediaControl  3  }

      tmxDeleteAll        OBJECT-TYPE
            SYNTAX              BITS { delete(0), keep(1)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "The flag indicates the deletion of the entire media
control database"
```

```
            ::=  {  tmxMediaControl  4  }

      tmxReserved          OBJECT-TYPE
            SYNTAX               INTEGER
            MAX-ACCESS           read-create
            STATUS               current
            DESCRIPTION          "The number of last Op created."
            ::=  {  tmxMediaControl  5  }
*****************************************************************************
**
      tmxIfTable                 OBJECT-TYPE
            SYNTAX               SEQUENCE  OF  TmxIfEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION
                  " This is the TMX specific extension of ifTable."
            ::=  { tmxMediaControl  6 }

      tmxIfEntry                 OBJECT-TYPE
            SYNTAX               TmxIfEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION          "tmxIfTable entry"
            INDEX          { ifIndex}
            ::=  { tmxIfTable 1 }

      TmxIfEntry  ::=  SEQUENCE {
            tmxIfName                          DisplayString,
            tmxIfTSId                          Integer32,
            tmxIfType                          BITS,
            tmxIfASIMode                 BITS,
            tmxIfStandard                BITS,
            tmxIfTransportBitRate        Integer32,
            tmxIfActionTrigger           ActionTriggerType,
            tmxIfActionTime                    DateAndTime,
            tmxIfIQ                      BITS,
            tmxIfSttDestinationOffset Integer32,
            tmxIfSttDsStatus             BITS,
            tmxIfSttDsDay              Integer32,
            tmxIfSttDsHour             Integer32,
            tmxIfPacketLength            BITS,
            tmxIfEntryStatus             RowStatus
            }
*****************************************************************************
**

      tmxIfName                  OBJECT-TYPE
            SYNTAX               DisplayString
            MAX-ACCESS           read-create
            STATUS               current
            DESCRIPTION
                        "User assigned name to the physical interface."
            ::=  {  tmxIfEntry  1  }


      tmxIfTSId                  OBJECT-TYPE
            SYNTAX               Integer32
```

```
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Mpeg Transport Identifier associated with this
physical interface, if any."
            ::=  {  tmxIfEntry  2  }


      tmxIfType                 OBJECT-TYPE
            SYNTAX              BITS { asi(0), ds3-ansi(1), ds3-fsi(2),
                                       dhei(3), dhei-high(4),
                                       smpte310(5), ds3-rmi(6)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "tmxIfType."
            ::=  {  tmxIfEntry  3  }


      tmxIfASIMode        OBJECT-TYPE
            SYNTAX              BITS { burst(0), byte(1)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Output ASI mode, burst or byte."
            ::=  {  tmxIfEntry  4  }


      tmxIfStandard       OBJECT-TYPE
            SYNTAX              BITS { atsc(0), dvb(1), mpeg2(2), none(3),
dcii(4)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Output ASI standard."
            ::=  {  tmxIfEntry  5  }


      tmxIfTransportBitRate             OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Transport bit rate in Mbps."
            ::=  {  tmxIfEntry  6  }


      tmxIfActionTrigger  OBJECT-TYPE
            SYNTAX              ActionTriggerType
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Trigger type that will initiate this operation."
            ::=  {  tmxIfEntry  7  }


      tmxIfActionTime           OBJECT-TYPE
            SYNTAX              DateAndTime
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
```

```
                        "If trigger type is a time of action this object
contains the time."
            ::=  {  tmxIfEntry  8  }


      tmxIfIQ                          OBJECT-TYPE
            SYNTAX              BITS {combined(0), i-out(1), q-out(2), iq-
split(3)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Select IQ mux mode for this transport stream,
combined, I, Q or I&Q."
            ::=  {  tmxIfEntry  9  }


    tmxIfSttDestinationOffset    OBJECT-TYPE
            SYNTAX           Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Offset from UTC as used in the STT. This may not be the
same value as used by the TMX system and may vary between transport streams
depending on destination"
            ::=  {  tmxIfEntry  10  }

    tmxIfSttDsStatus       OBJECT-TYPE
            SYNTAX              BITS { not-in-ds(0), in-ds(1)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Daylight savings status as used in the STT."
            ::=  {  tmxIfEntry  11  }


    tmxIfSttDsDay          OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Local day of month daylight savings status will change (1-
31) as used in the STT."
            ::=  {  tmxIfEntry  12  }


    tmxIfSttDsHour         OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Local hour of day daylight savings status will change (0-
18) as used in the STT."
            ::=  {  tmxIfEntry  13  }


   tmxIfPacketLength       OBJECT-TYPE
            SYNTAX              BITS { pkt188(0), pkt204(1)}
            MAX-ACCESS          read-create
```

```
            STATUS              current
            DESCRIPTION         "Transport stream packet length."
            ::=  {  tmxIfEntry  14  }


    tmxIfEntryStatus       OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Status of this entry."
            ::=  {  tmxIfEntry  15  }


****************************************************************************
**
      tmxIfGiExtTable           OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxIfGiExtEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  " This is the extension table defining  the DS3-GI TMX
interface
                    parameters."
            ::=  { tmxMediaControl  7 }

      tmxIfGiExtEntry           OBJECT-TYPE
            SYNTAX              TmxIfGiExtEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "tmxIfGIExtTable entry"
            INDEX         { ifIndex}
            ::=  { tmxIfGiExtTable 1 }


      TmxIfGiExtEntry  ::=  SEQUENCE {
            tmxIfGiExtCodeRate        BITS,
            tmxIfGiExtSymbolRate      BITS,
            tmxIfGiExtModType         BITS,
            tmxIfGiExtPowerLevel      Integer32,
            tmxIfGiExtCarrierFrq      Integer32,
            tmxIfGiExtCwMode          BITS,
            tmxIfGiExtMute                  BITS,
            tmxIfGiExtEntryStatus     RowStatus
            }
****************************************************************************
**

      tmxIfGiExtCodeRate        OBJECT-TYPE
            SYNTAX              BITS { cr-5-11(0), cr-1-2(1), cr-3-5(2),
                                       cr-2-3(3), cr-3-4(4), cr-4-5(5),
                                       cr-5-6(6), cr-7-8(7)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Code rate: 5/11, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6,
                                    7/8"
```

```
        ::=  {  tmxIfGiExtEntry 1  }


    tmxIfGiExtSymbolRate              OBJECT-TYPE
        SYNTAX              BITS { sr-38-8(0), sr-29-27(1),
                                   sr-19-51(2), sr-14-63(3),
                                   sr-11-71(4), sr-9-76(5),
                                   sr-7-32(6), sr-4-88(7),
                                   sr-3-25(8), sr-2-44(9),
                                   sr-1-83(10)}
        MAX-ACCESS          read-create
        STATUS              current
        DESCRIPTION
                    "Symbol rate: 38.8 29.27, 19.51, 14.63, 11.71,
                         9.76, 7.32, 4.88, 3.25, 2.44,1.83"
        ::=  {  tmxIfGiExtEntry  2  }


    tmxIfGiExtModType   OBJECT-TYPE
        SYNTAX              BITS { qpsk(0), bpsk(1), oqpsk(2)}
        MAX-ACCESS          read-create
        STATUS              current
        DESCRIPTION         "Modulation type."
        ::=  {  tmxIfGiExtEntry  3  }


    tmxIfGiExtPowerLevel              OBJECT-TYPE
        SYNTAX              Integer32
        MAX-ACCESS          read-create
        STATUS              current
        DESCRIPTION
                    "Power level: 0-20 representing -5dBm to -15dBm in
0.5dBm steps."
        ::=  {  tmxIfGiExtEntry 4 }


    tmxIfGiExtCarrierFrq              OBJECT-TYPE
        SYNTAX              Integer32
        MAX-ACCESS          read-create
        STATUS              current
        DESCRIPTION
                    "47000 kHz - 93000 kHz for the 70 MHz band and
                          104000 khz - 176000 kHz for the 140 MHz band.
                          The frequency must be in steps of 125 kHz."
        ::=  {  tmxIfGiExtEntry 5  }


    tmxIfGiExtCwMode    OBJECT-TYPE
        SYNTAX              BITS { modulated(0), unmodulated(1)}
        MAX-ACCESS          read-create
        STATUS              current
        DESCRIPTION         "IF carrier to be unmodulated."
        ::=  {  tmxIfGiExtEntry  6  }


    tmxIfGiExtMute              OBJECT-TYPE
        SYNTAX              BITS { notMuted(0), muted(1)}
```

```
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "IF carrier to be muted."
            ::=  {  tmxIfGiExtEntry  7  }


      tmxIfGiExtEntryStatus            OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Status of this entry."
            ::=  {  tmxIfGiExtEntry 8  }

*****************************************************************************
**
      tmxStatGroupTable   OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxStatGroupEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "The StatGroup Control table. Each row in this
                  table represents a create/delete Op command. All
                  Ops with the same Time of Action are to be executed
                  in the order specified by the message index.
                  Program elements within a StatGroup can be
                  Constant Bit Rate (CBR) in which case their minBw=maxBw,
                  Variable Bit Rate (VBR) in which case their minBw<maxBw,
                  and opportunistic in which case they use up only spare Bw
                  left unused after all CBR and VBR programs are multiplexed"
            ::=  { tmxMediaControl  8 }

      tmxStatGroupEntry   OBJECT-TYPE
            SYNTAX              TmxStatGroupEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "StatGroupTable entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex }
            ::=  { tmxStatGroupTable 1 }

      TmxStatGroupEntry  ::=  SEQUENCE {
            tmxStatGroupOpIndex              Integer32,
            tmxStatGroupMsg                  BITS,
            tmxStatGroupId                         Integer32,
            tmxStatGroupSize                 Integer32,
            tmxStatGroupTranscBwPercent Integer32,
            tmxStatGroupMaxInputBw     Integer32,
            tmxStatGroupMaxOutputBw    Integer32,
            tmxStatGroupActionTrigger  ActionTriggerType,
            tmxStatGroupActionTime           DateAndTime,
            tmxStatGroupStatus               RowStatus
            }
*****************************************************************************
**

      tmxStatGroupOpIndex        OBJECT-TYPE
            SYNTAX              Integer32
```

```
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "This is used for unique identification and sequencing of
all
                  operational configuration messages. The value is the value
of
                  tmxOpNum when entry was created and is set by the manager."
            ::=  {  tmxStatGroupEntry  1  }


      tmxStatGroupMsg           OBJECT-TYPE
            SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message. The message
                  type indicates whether the Command type is to either create
                  or delete the item described in this row. Any create command
                  is further restricted by the Action Trigger Type. Depending
on
                  the Action Trigger Type, the command will either be
immediately
                  executed, executed at a time specidfied by Time of Action,
or
                  executed when a SPliceImmediateFlag is raised."
            ::=  {  tmxStatGroupEntry  2  }


      tmxStatGroupId            OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Group identifier in control multiplex."
            ::=  {  tmxStatGroupEntry  3  }


      tmxStatGroupSize    OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Number of members in group."
            ::=  {  tmxStatGroupEntry  4  }


      tmxStatGroupTranscBwPercent      OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Percentage of overall bandwidth to allocate to multiplex
group,
                  if transcoded."
            ::=  {  tmxStatGroupEntry  5  }
```

```
       tmxStatGroupMaxInputBw     OBJECT-TYPE
              SYNTAX              Integer32
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Define maximum bandwidth to allocate to this input stat
group,
                            if stat group is input."
              ::=  {  tmxStatGroupEntry  6  }


       tmxStatGroupMaxOutputBw    OBJECT-TYPE
              SYNTAX              Integer32
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Define maximum bandwidth to allocate to this output stat
group,
                            if stat group is input."
              ::=  {  tmxStatGroupEntry  7  }


       tmxStatGroupActionTrigger  OBJECT-TYPE
              SYNTAX              ActionTriggerType
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Trigger type that will initiate this operation."
              ::=  {  tmxStatGroupEntry  8  }


       tmxStatGroupActionTime           OBJECT-TYPE
              SYNTAX              DateAndTime
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "If trigger type is a time of action this object contains
the time."
              ::=  {  tmxStatGroupEntry  9  }


       tmxStatGroupStatus         OBJECT-TYPE
              SYNTAX              RowStatus
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION         "Status of this row."
              ::=  {  tmxStatGroupEntry  10  }

*******************************************************************************
**
       tmxProgTable          OBJECT-TYPE
              SYNTAX              SEQUENCE  OF  TmxProgEntry
              MAX-ACCESS          not-accessible
              STATUS              current
              DESCRIPTION
                     "The MPEG Service/Program  Control table. Each row in this
                     table represents a create/delete Op command. All
```

```
                    Ops with the same Time of Action are to be executed
                    in the order specified by the message index.
                    This table is used to create programs in the output
                    multiplex and to associate programs with possibly
                    external input sources. It is not used to route a
                    complete program from input to output. All routing is done
                    by the Program Component Table."
             ::=  { tmxMediaControl  9 }

      tmxProgEntry         OBJECT-TYPE
             SYNTAX               TmxProgEntry
             MAX-ACCESS           not-accessible
             STATUS               current
             DESCRIPTION
                    "Entry into the Program Control table."
             INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex }
             ::=  { tmxProgTable 1 }

      TmxProgEntry  ::=  SEQUENCE {
             tmxProgOpIndex       Integer32,
             tmxProgMsg           BITS,
             tmxProgGrpId               Integer32,
             tmxProgEncIPAddr     IpAddress,
             tmxProgEncPort             Integer32,
             tmxProgTmxIPAddr     IpAddress,
             tmxProgTmxPort             Integer32,
             tmxProgProgId              Integer32,
             tmxProgProgName      DisplayString,
             tmxProgPcrPID              Integer32,
             tmxProgGIDS3IQ             BITS,
             tmxProgActionTrigger       ActionTriggerType,
             tmxProgActionTime    DateAndTime,
             tmxProgStatus              RowStatus
             }
*******************************************************************************
**

      tmxProgOpIndex              OBJECT-TYPE
             SYNTAX               Integer32
             MAX-ACCESS           not-accessible
             STATUS               current
             DESCRIPTION
                    "This is used for unique identification and sequencing of
all
                    operational configuration messages. The value is the value
of
                    tmxOpNum when entry was created and is set by the manager."
             ::=  {  tmxProgEntry  1  }


      tmxProgMsg                  OBJECT-TYPE
             SYNTAX               BITS  { create ( 0 ) , delete ( 1 ) }
             MAX-ACCESS           read-create
             STATUS               current
             DESCRIPTION
                    "Each table row constitutes a command message. The message
                    type indicates whether the Command type is to either create
```

```
                    or delete the item described in this row. Any create command
                    is further restricted by the Action Trigger Type. Depending
on
                    the Action Trigger Type, the command will either be
immediately
                    executed, executed at a time specidfied by Time of Action,
or
                    executed when a SPliceImmediateFlag is raised."
              ::=  {  tmxProgEntry  2  }


       tmxProgGrpId         OBJECT-TYPE
              SYNTAX               Integer32
              MAX-ACCESS           read-create
              STATUS               current
              DESCRIPTION
                    "Statistical Group identifier in output multiplex,
                    if part of a statistical group."
              ::=  {  tmxProgEntry  3  }


       tmxProgEncIPAddr     OBJECT-TYPE
              SYNTAX               IpAddress
              MAX-ACCESS           read-create
              STATUS               current
              DESCRIPTION
                           "If any, IP address of the encoder for this service
for
                            distributed stat mux."
              ::=  {  tmxProgEntry  4  }


       tmxProgEncPort             OBJECT-TYPE
              SYNTAX               Integer32
              MAX-ACCESS           read-create
              STATUS               current
              DESCRIPTION
                           "If any, Port number of the encoder for this service
for
                            distributed stat mux."
              ::=  {  tmxProgEntry  5  }


       tmxProgTmxIPAddr     OBJECT-TYPE
              SYNTAX               IpAddress
              MAX-ACCESS           read-create
              STATUS               current
              DESCRIPTION
                    "If any, IP address of the TMX for this service for
distributed
                           stat mux."
              ::=  {  tmxProgEntry  6  }


       tmxProgTmxPort             OBJECT-TYPE
              SYNTAX               Integer32
              MAX-ACCESS           read-create
```

```
            STATUS              current
            DESCRIPTION
                  "If any, Port number of the TMX for this service for
distributed
                        stat mux."
            ::=  {  tmxProgEntry  7  }


      tmxProgProgId       OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Output MPEG program (i.e. service) number."
            ::=  {  tmxProgEntry  8  }


      tmxProgProgName           OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Output program name assigned by the user."
            ::=  {  tmxProgEntry  9  }


      tmxProgPcrPID       OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "PCR PID associated with the program."
            ::=  {  tmxProgEntry  10  }


      tmxProgGIDS3IQ            OBJECT-TYPE
            SYNTAX              BITS  { splitI ( 0 ) , splitQ ( 1 ) , combined
(2) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message."
            ::=  {  tmxProgEntry  11  }


      tmxProgActionTrigger            OBJECT-TYPE
            SYNTAX              ActionTriggerType
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Trigger type that will initiate this operation."
            ::=  {  tmxProgEntry  12  }


      tmxProgActionTime   OBJECT-TYPE
            SYNTAX              DateAndTime
            MAX-ACCESS          read-create
```

```
            STATUS              current
            DESCRIPTION
                  "If trigger type is a time of action this object contains
the time."
            ::=  {  tmxProgEntry  13  }


      tmxProgStatus       OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Status of the row."
            ::=  {  tmxProgEntry  14  }
*******************************************************************************
**
      tmxProgCompTable    OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxProgCompEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
            "The MPEG Service/Program  Component Control table. Each row in
this
            table represents a create/delete Op command. All
            Ops with the same Time of Action are to be executed
            in the order specified by the message index."
            ::=  { tmxMediaControl  10 }

      tmxProgCompEntry    OBJECT-TYPE
            SYNTAX              TmxProgCompEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION         "Entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxProgCompOpIndex }
            ::=  { tmxProgCompTable 1 }

      TmxProgCompEntry  ::=  SEQUENCE {
            tmxProgCompOpIndex                Integer32,
            tmxProgCompMsg                    BITS,
            tmxProgCompTpeId                  Integer32,
            tmxProgCompSrcId            Integer32,
            tmxProgCompPID                    Integer32,
            tmxProgCompAliasPID               Integer32,
            tmxProgCompStreamType             BITS,
            tmxProgCompPriority               Integer32,
            tmxProgCompTrcMode                BITS,
            tmxProgCompEmbededPCR             BITS,
            tmxProgCompActionTrigger   ActionTriggerType,
            tmxProgCompActionTime             DateAndTime,
            tmxProgCompMinBw                  Integer32,
            tmxProgCompMaxBw                  Integer32,
            tmxProgCompStatus                 RowStatus
            }
*******************************************************************************
**
```

```
        tmxProgCompOpIndex  OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "This is used for unique identification and sequencing of
all
                        operational configuration messages. The value is the value
of
                        tmxOpNum when entry was created and is set by the manager."
                ::=  {  tmxProgCompEntry  1  }


        tmxProgCompMsg      OBJECT-TYPE
                SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Each table row constitutes a command message. The message
                        type indicates whether the Command type is to either create
                        or delete the item described in this row. Any create command
                        is further restricted by the Action Trigger Type. Depending
on
                        the Action Trigger Type, the command will either be
immediately
                        executed, executed at a time specidfied by Time of Action,
or
                        executed when a SPliceImmediateFlag is raised."
                ::=  {  tmxProgCompEntry  2  }


        tmxProgCompTpeId    OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Identifier of the TPE to process this component,
                         if any."
                ::=  {  tmxProgCompEntry  3  }


        tmxProgCompSrcId    OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Physical input source identifer (ifIndex)"
                ::=  {  tmxProgCompEntry  4  }


        tmxProgCompPID              OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "MPEG Input PID"
                ::=  {  tmxProgCompEntry  5  }
```

```
        tmxProgCompAliasPID OBJECT-TYPE
               SYNTAX              Integer32
               MAX-ACCESS          read-create
               STATUS              current
               DESCRIPTION
                      "User assigned Component PID number in the output multiplex
                      to create or delete."
               ::=  {  tmxProgCompEntry  6  }


        tmxProgCompStreamType              OBJECT-TYPE
               SYNTAX              BITS  { video ( 0 ) , audio ( 1 ) , data ( 2 )
}
               MAX-ACCESS          read-create
               STATUS              current
               DESCRIPTION
                      "Stream content type of the MPEG component to be
                      created or deleted."
               ::=  {  tmxProgCompEntry  7  }


        tmxProgCompPriority        OBJECT-TYPE
               SYNTAX              Integer32
               MAX-ACCESS          read-create
               STATUS              current
               DESCRIPTION
                      "This is a value between 1 (lowest) and 10 and indicates the
                      minimum video quality (quantization level) after which
                      opportunistic data can be added to the statistical
                      multiplex group. Alternatively, if data within the group
                      is guaranteed the this indicates the relative priority
                      of the video within the group."
               ::=  {  tmxProgCompEntry  8  }


        tmxProgCompTrcMode         OBJECT-TYPE
               SYNTAX              BITS  { transcode ( 0 ) , passthru ( 1 ) }
               MAX-ACCESS          read-create
               STATUS              current
               DESCRIPTION
                             "Transcode or passthrough this component."
               ::=  {  tmxProgCompEntry  9  }


        tmxProgCompEmbededPCR              OBJECT-TYPE
               SYNTAX              BITS  { enable ( 0 ) , disable ( 1 ) }
               MAX-ACCESS          read-create
               STATUS              current
               DESCRIPTION         "PCR mode."
               ::=  {  tmxProgCompEntry  10  }


        tmxProgCompActionTrigger   OBJECT-TYPE
               SYNTAX              ActionTriggerType
               MAX-ACCESS          read-create
```

```
            STATUS              current
            DESCRIPTION
                  "Trigger type that will initiate this operation."
            ::=  {  tmxProgCompEntry  11  }


      tmxProgCompActionTime            OBJECT-TYPE
            SYNTAX              DateAndTime
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "If trigger type is a time of action this object contains
the time."
            ::=  {  tmxProgCompEntry  12  }


      tmxProgCompMinBw    OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Minimum bandwidth for program component.
                         If minimum = maximum the bandwidth is fixed, i.e.
not
                         statistically multiplexed."
            ::=  {  tmxProgCompEntry  13  }


      tmxProgCompMaxBw    OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Maximum bandwidth for program component.
                         If minimum = maximum the bandwidth is fixed, i.e.
not
                         statistically multiplexed."
            ::=  {  tmxProgCompEntry  14  }


      tmxProgCompStatus   OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Status of the row."
            ::=  {  tmxProgCompEntry  15  }
*****************************************************************************
**
      tmxIPDataTable            OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxIPDataEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "The IP Data  Component Control table. Each row in this
                  table represents a create/delete Op command. All
                  Ops with the same Time of Action are to be executed
```

```
                in the order specified by the message index."
            ::=  { tmxMediaControl  11 }

      tmxIPDataEntry            OBJECT-TYPE
            SYNTAX              TmxIPDataEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "Entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex,
tmxIPDataOpIndex }
            ::=  { tmxIPDataTable 1 }

      TmxIPDataEntry  ::=  SEQUENCE {
            tmxIPDataOpIndex                  Integer32,
            tmxIPDataMsg                            BITS,
            tmxIPDataPID                            Integer32,
            tmxIPDataDestAddr                 IpAddress,
            tmxIPDataFlowCtlType              BITS,
            tmxIPDataTmxFlowCtlServerAddr     IpAddress,
            tmxIPDataTmxFlowCtlServerPort     Integer32,
            tmxIPDataTmxFlowCtlAddr    IpAddress,
            tmxIPDataTmxFlowCtlPort    Integer32,
            tmxIPDataMuxMode                  BITS,
            tmxIPDataOutMode                  BITS,
            tmxIPDataAvgBitRate               Integer32,
            tmxIPDataAvgTimePeriod     Integer32,
            tmxIPDataMinBitRate               Integer32,
            tmxIPDataMaxBitRate               Integer32,
            tmxIPDataActionTrigger            ActionTriggerType,
            tmxIPDataActionTime               DateAndTime,
            tmxIPDataSectionLength         BITS,
            tmxIPDataStatus                   RowStatus
            }
*******************************************************************************
**

      tmxIPDataOpIndex    OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "This is used for unique identification and sequencing of
all
                  operational configuration messages. The value is the value
of
                  tmxOpNum when entry was created and is set by the manager."
            ::=  {  tmxIPDataEntry  1  }


      tmxIPDataMsg        OBJECT-TYPE
            SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message. The message
                  type indicates whether the Command type is to either create
```

```
                    or delete the item described in this row. Any create command
                    is further restricted by the Action Trigger Type. Depending
on
                    the Action Trigger Type, the command will either be
immediately
                    executed, executed at a time specidfied by Time of Action,
or
                            executed when a SPliceImmediateFlag is raised."
             ::=  {  tmxIPDataEntry  2  }


      tmxIPDataPID        OBJECT-TYPE
             SYNTAX              Integer32
             MAX-ACCESS          read-create
             STATUS              current
             DESCRIPTION
                    "MPEG PID number in output transport for this data stream.
                    There may be multiple IP data route entries for the same
PID!!!"
             ::=  {  tmxIPDataEntry  3  }


      tmxIPDataDestAddr   OBJECT-TYPE
             SYNTAX              IpAddress
             MAX-ACCESS          read-create
             STATUS              current
             DESCRIPTION
                    "IP address of destination host or network that this PID
will
                    route data for."
             ::=  {  tmxIPDataEntry  4  }


      tmxIPDataFlowCtlType              OBJECT-TYPE
             SYNTAX              BITS  { none ( 0 ) , smpte-325m ( 1 ) }
             MAX-ACCESS          read-create
             STATUS              current
             DESCRIPTION
                    "The type of flow control used by the TMX to throttle the
data server"
             ::=  {  tmxIPDataEntry  5  }


      tmxIPDataTmxFlowCtlServerAddr    OBJECT-TYPE
             SYNTAX              IpAddress
             MAX-ACCESS          read-create
             STATUS              current
             DESCRIPTION
                    "Server IP Address for flow control of this data stream."
             ::=  {  tmxIPDataEntry  6  }


      tmxIPDataTmxFlowCtlServerPort    OBJECT-TYPE
             SYNTAX              Integer32
             MAX-ACCESS          read-create
             STATUS              current
             DESCRIPTION
```

```
                    "Port number of the server's  IP port for flow control of
this data stream."
              ::=  {  tmxIPDataEntry  7  }


       tmxIPDataTmxFlowCtlAddr          OBJECT-TYPE
              SYNTAX              IpAddress
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "TMX IP Address for flow control of this data stream."
              ::=  {  tmxIPDataEntry  8  }


       tmxIPDataTmxFlowCtlPort          OBJECT-TYPE
              SYNTAX              Integer32
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Port number of TMX's IP flow control port for this data
stream."
              ::=  {  tmxIPDataEntry  9  }


       tmxIPDataMuxMode    OBJECT-TYPE
              SYNTAX              BITS  { guaranteed ( 0 ) , opportunistic ( 1 )
}
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Data multiplexing mode. Either guaranteed, in which case
either
              sufficiently much multiplexing bandwidth is allocated or the
              video quality will be sacrificed in a statistical multiplex;
              or opportunistic in which case data multiplexing is dependent
              on spare bandwidth after desired video quality is achieved"
              ::=  {  tmxIPDataEntry  10  }


       tmxIPDataOutMode    OBJECT-TYPE
              SYNTAX              BITS  { atsc( 0 ) , dvb ( 1 ), other ( 2 ) }
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                           "IP data encapsulation."
              ::=  {  tmxIPDataEntry  11  }


       tmxIPDataAvgBitRate        OBJECT-TYPE
              SYNTAX              Integer32
              MAX-ACCESS          read-create
              STATUS              current
              DESCRIPTION
                     "Average data bit rate over tmxIPDataAvgTimePeriod, if any."
              ::=  {  tmxIPDataEntry  12  }
```

```
        tmxIPDataAvgTimePeriod              OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Averaging time period in Seconds, if any."
                ::=  {  tmxIPDataEntry  13  }


        tmxIPDataMinBitRate         OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Minimum guaranteed or desired bit rate over
tmxIPDataAvgTimePeriod,
                                if any."
                ::=  {  tmxIPDataEntry  14  }


        tmxIPDataMaxBitRate         OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Maximum guaranteed or desired bit rate over
tmxIPDataAvgTimePeriod,
                                if any."
                ::=  {  tmxIPDataEntry  15  }


        tmxIPDataActionTrigger              OBJECT-TYPE
                SYNTAX              ActionTriggerType
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Trigger type that will initiate this operation."
                ::=  {  tmxIPDataEntry  16  }


        tmxIPDataActionTime         OBJECT-TYPE
                SYNTAX              DateAndTime
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "If trigger type is a time of action this object contains
the time."
                ::=  {  tmxIPDataEntry  17  }


        tmxIPDataSectionLength              OBJECT-TYPE
                SYNTAX              BITS { len4096(0), len1024(1)}
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION         "Maximum length of DSM-CC sections."
```

```
            ::=  {  tmxIPDataEntry  18  }

      tmxIPDataStatus                  OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Status of the row."
            ::=  {  tmxIPDataEntry  19 }

**********************************************************************************
**
      tmxAsyncDataTable          OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxAsyncDataEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
            "The RS-232/RS-422 Data  Component Control table. Each row in this
            table represents a create/delete Op command. All
            Ops with the same Time of Action are to be executed
            in the order specified by the message index."
            ::=  { tmxMediaControl  12 }

      tmxAsyncDataEntry          OBJECT-TYPE
            SYNTAX              TmxAsyncDataEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "Entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxAsyncDataOpIndex }
            ::=  { tmxAsyncDataTable 1 }

      TmxAsyncDataEntry  ::=  SEQUENCE {
            tmxAsyncDataOpIndex              Integer32,
            tmxAsyncDataMsg                  BITS,
            tmxAsyncDataSrcId                Integer32,
            tmxAsyncDataPID                  Integer32,
            tmxAsyncDataBaudRate             Integer32,
            tmxAsyncDataParity               Integer32,
            tmxAsyncDataBits                 Integer32,
            tmxAsyncDataStopBits             Integer32,
            tmxAsyncDataFlowControl    BITS,
            tmxAsyncDataMuxMode              BITS,
            tmxAsyncDataOutMode              BITS,
            tmxAsyncDataAvgBitRate     Integer32,
            tmxAsyncDataAvgTimePeriod        Integer32,
            tmxAsyncDataMinBitRate     Integer32,
            tmxAsyncDataMaxBitRate     Integer32,
            tmxAsyncDataActionTrigger  ActionTriggerType,
            tmxAsyncDataActionTime           DateAndTime,
            tmxAsyncDataStatus               RowStatus
            }
**********************************************************************************
**
```

```
        tmxAsyncDataOpIndex         OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "This is used for unique identification and sequencing of
all
                        operational configuration messages. The value is the value
of
                        tmxOpNum when entry was created and is set by the manager."
                ::=  {  tmxAsyncDataEntry  1  }


        tmxAsyncDataMsg                     OBJECT-TYPE
                SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Each table row constitutes a command message. The message
                        type indicates whether the Command type is to either create
                        or delete the item described in this row. Any create command
                        is further restricted by the Action Trigger Type. Depending
on
                        the Action Trigger Type, the command will either be
immediately
                        executed, executed at a time specidfied by Time of Action,
or
                        executed when a SPliceImmediateFlag is raised."
                ::=  {  tmxAsyncDataEntry  2  }


        tmxAsyncDataSrcId           OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Physical input identifier (ifIndex)."
                ::=  {  tmxAsyncDataEntry  3  }


        tmxAsyncDataPID                     OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "MPEG PID number in output multiplex for this data
stream."
                ::=  {  tmxAsyncDataEntry  4  }


        tmxAsyncDataBaudRate                OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "RS-232 baud rate setting, if any."
                ::=  {  tmxAsyncDataEntry  5  }
```

```
        tmxAsyncDataParity          OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                                "RS-232 parity, if any."
                ::=  {  tmxAsyncDataEntry  6  }


        tmxAsyncDataBits            OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                                "RS-232 number of data bits, if any."
                ::=  {  tmxAsyncDataEntry  7  }


        tmxAsyncDataStopBits                OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                                "RS-232, number of stop bits, if any."
                ::=  {  tmxAsyncDataEntry  8  }


        tmxAsyncDataFlowControl             OBJECT-TYPE
                SYNTAX              BITS  { xonxoff ( 0 ) , hw ( 1 ) , none ( 2 )
}
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                                "RS-232 flow control, if any."
                ::=  {  tmxAsyncDataEntry  9  }


        tmxAsyncDataMuxMode         OBJECT-TYPE
                SYNTAX              BITS  { guaranteed ( 0 ), opportunistic ( 1 )
}
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Data multiplexing mode. Either guaranteed, in which case
either
                        sufficiently much multiplexing bandwidth is allocated or the
                        video quality will be sacrificed in a statistical multiplex;
                        or opportunistic in which case data multiplexing is
dependent
                        on spare bandwidth after desired video quality is achieved"
                ::=  {  tmxAsyncDataEntry  10  }


        tmxAsyncDataOutMode         OBJECT-TYPE
                SYNTAX              BITS  { atsc ( 0 ) , dvb ( 1 ) }
```

```
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Data encapsulation on output."
            ::=  {  tmxAsyncDataEntry  11  }


      tmxAsyncDataAvgBitRate          OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Average data bit rate over
tmxAsyncDataAvgTimePeriod, if any."
            ::=  {  tmxAsyncDataEntry  12  }


      tmxAsyncDataAvgTimePeriod  OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Averaging time period in Seconds, if any."
            ::=  {  tmxAsyncDataEntry  13  }


      tmxAsyncDataMinBitRate          OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Minimum guaranteed or desired bit rate over
                         tmxAsyncDataAvgTimePeriod, if any."
            ::=  {  tmxAsyncDataEntry  14  }


      tmxAsyncDataMaxBitRate          OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Maximum guaranteed or desired bit rate over
                         tmxAsyncDataAvgTimePeriod, if any."
            ::=  {  tmxAsyncDataEntry  15  }


      tmxAsyncDataActionTrigger  OBJECT-TYPE
            SYNTAX              ActionTriggerType
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Trigger type that will initiate this operation."
            ::=  {  tmxAsyncDataEntry  16  }


      tmxAsyncDataActionTime          OBJECT-TYPE
            SYNTAX              DateAndTime
```

```
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "If trigger type is a time of action this object
contains the time."
            ::=  {  tmxAsyncDataEntry  17  }


      tmxAsyncDataStatus        OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Status of the row."
            ::=  {  tmxAsyncDataEntry  18  }

*******************************************************************************
**
      tmxCarouselTable          OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxCarouselEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "The Carousel Control table. Each row in this
                  table represents a create/delete Op command. All
                  Ops with the same Time of Action are to be executed
                  in the order specified by the message index."
            ::=  { tmxMediaControl  13 }

      tmxCarouselEntry          OBJECT-TYPE
            SYNTAX              TmxCarouselEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "Entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxCarouselOpIndex }
            ::=  { tmxCarouselTable 1 }

      TmxCarouselEntry  ::=  SEQUENCE {
            tmxCarouselOpIndex              Integer32,
            tmxCarouselMsg                  BITS,
            tmxCarouselPID                  Integer32,
            tmxCarouselOutStandard          BITS,
            tmxCarouselRepetitionRate  Integer32,
            tmxCarouselLoadData             OCTET STRING,
            tmxCarouselActionTrigger   ActionTriggerType,
            tmxCarouselActionTime           DateAndTime,
            tmxCarouselOnDemand             BITS,
            tmxCarouselStatus               RowStatus
            }
*******************************************************************************
**

      tmxCarouselOpIndex        OBJECT-TYPE
            SYNTAX              Integer32
```

```
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "This is used for unique identification and sequencing of
all
                   operational configuration messages. The value is the value
of
                   tmxOpNum when entry was created and is set by the manager."
            ::=  {  tmxCarouselEntry  1  }

      tmxCarouselMsg                    OBJECT-TYPE
            SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message. The message
                   type indicates whether the Command type is to either create
                   or delete the item described in this row. Any create
command
                   is further restricted by the Action Trigger Type. Depending
on
                   the Action Trigger Type, the command will either be
immediately
                   executed, executed at a time specidfied by Time of Action,
or
                   executed when a SPliceImmediateFlag is raised."
            ::=  {  tmxCarouselEntry  2  }


      tmxCarouselPID                    OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "MPEG PID number in output multiplex."
            ::=  {  tmxCarouselEntry  3  }


      tmxCarouselOutStandard            OBJECT-TYPE
            SYNTAX              BITS  { atsc ( 0 ) , dvb ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Data encapsulation on output, if any."
            ::=  {  tmxCarouselEntry  4  }


      tmxCarouselRepetitionRate  OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Repetition rate of the data in milliseconds."
            ::=  {  tmxCarouselEntry  5  }


      tmxCarouselLoadData       OBJECT-TYPE
```

```
            SYNTAX              OCTET STRING
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "File name on server or if LoadHost=NULL, this
                        is the data itself that is to be put onto the
                        Carousel."
            ::=  {  tmxCarouselEntry  6  }

      tmxCarouselActionTrigger   OBJECT-TYPE
            SYNTAX              ActionTriggerType
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Trigger type that will initiate this operation."
            ::=  {  tmxCarouselEntry  7  }


      tmxCarouselActionTime            OBJECT-TYPE
            SYNTAX              DateAndTime
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "If trigger type is a time of action this object
contains the time."
            ::=  {  tmxCarouselEntry  8  }


    tmxCarouselOnDemand         OBJECT-TYPE
            SYNTAX              BITS { disabled(0), enabled(1)}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Switch for on-demand table generation"
            ::=  {  tmxCarouselEntry  9  }

      tmxCarouselStatus   OBJECT-TYPE
            SYNTAX              RowStatus
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION         "Status of the row."
            ::=  {  tmxCarouselEntry  10  }

*****************************************************************************
**
      tmxFifoTable        OBJECT-TYPE
            SYNTAX              SEQUENCE  OF  TmxFifoEntry
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "The FIFO Control table. Each row in this
                  table represents a create/delete Op command. All
                  Ops with the same Time of Action are to be executed
                  in the order specified by the message index."
            ::=  { tmxMediaControl  14 }

      tmxFifoEntry        OBJECT-TYPE
            SYNTAX              TmxFifoEntry
```

```
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "Entry"
            INDEX         { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxFifoOpIndex }
            ::=  { tmxFifoTable 1 }

      TmxFifoEntry  ::=  SEQUENCE {
            tmxFifoOpIndex            Integer32,
            tmxFifoMsg                BITS,
            tmxFifoPID                Integer32,
            tmxFifoOutStandard        BITS,
            tmxFifoAvgBitRate         Integer32,
            tmxFifoAvgTimePeriod      Integer32,
            tmxFifoMinBitRate         Integer32,
            tmxFifoMaxBitRate         Integer32,
            tmxFifoLoadTime           Integer32,
            tmxFifoLoadType           BITS,
            tmxFifoLoadHost           IpAddress,
            tmxFifoFileName           DisplayString,
            tmxFifoLoadDataType       BITS,
            tmxFifoActionTrigger      ActionTriggerType,
            tmxFifoActionTime         DateAndTime,
            tmxFifoOnDemand                 BITS,
            tmxFifoStatus                   RowStatus
            }
**************************************************************************
**

      tmxFifoOpIndex            OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "This is used for unique identification and sequencing of
all
                   operational configuration messages. The value is the value
of
                   tmxOpNum when entry was created and is set by the manager."
            ::=  {  tmxFifoEntry  1  }

      tmxFifoMsg                OBJECT-TYPE
            SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message. The message
                   type indicates whether the Command type is to either create
                   or delete the item described in this row. Any create
command
                   is further restricted by the Action Trigger Type. Depending
on
                   the Action Trigger Type, the command will either be
immediately
                   executed, executed at a time specidfied by Time of Action,
or
```

```
                executed when a SPliceImmediateFlag is raised."
        ::=  {  tmxFifoEntry  2  }


    tmxFifoPID                  OBJECT-TYPE
        SYNTAX                  Integer32
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "MPEG PID number in output multiplex."
        ::=  {  tmxFifoEntry  3  }


    tmxFifoOutStandard          OBJECT-TYPE
        SYNTAX                  BITS  { atsc ( 0 ) , dvb ( 1 ) }
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "Data encapsulation on output, if any."
        ::=  {  tmxFifoEntry  4  }


    tmxFifoAvgBitRate           OBJECT-TYPE
        SYNTAX                  Integer32
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "Average data bit rate over tmxFifoAvgTimePeriod, if
any."
        ::=  {  tmxFifoEntry  5  }


    tmxFifoAvgTimePeriod        OBJECT-TYPE
        SYNTAX                  Integer32
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "Averaging time period in Seconds, if any."
        ::=  {  tmxFifoEntry  6  }


    tmxFifoMinBitRate           OBJECT-TYPE
        SYNTAX                  Integer32
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "Minimum guaranteed or desired bit rate over
                     tmxFifoAvgTimePeriod, if any."
        ::=  {  tmxFifoEntry  7  }


    tmxFifoMaxBitRate           OBJECT-TYPE
        SYNTAX                  Integer32
        MAX-ACCESS              read-create
        STATUS                  current
        DESCRIPTION
                    "Maximum guaranteed or desired bit rate over
```

```
                        tmxFifoAvgTimePeriod, if any."
            ::=  {  tmxFifoEntry  8  }


      tmxFifoLoadTime           OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Time at which to load the file from server, if any."
            ::=  {  tmxFifoEntry  9 }

      tmxFifoLoadType           OBJECT-TYPE
            SYNTAX              BITS  { tftp ( 0 ) , ftp( 1 ) , nfs ( 2 ) ,
snmpdata ( 3 )}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "FIFO load protocol."
            ::=  {  tmxFifoEntry  10 }


      tmxFifoLoadHost           OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "IP address of server."
            ::=  {  tmxFifoEntry  11  }


      tmxFifoFileName           OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "File name on server."
            ::=  {  tmxFifoEntry  12  }

      tmxFifoLoadDataType       OBJECT-TYPE
            SYNTAX              BITS  { data ( 0 ) , dsmcc ( 1 ) ,
prepacketized ( 2 )}
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Format of data to be put onto the FIFO."
            ::=  {  tmxFifoEntry  13  }

      tmxFifoActionTrigger      OBJECT-TYPE
            SYNTAX              ActionTriggerType
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Trigger type that will initiate this operation."
            ::=  {  tmxFifoEntry  14  }
```

```
        tmxFifoActionTime           OBJECT-TYPE
                SYNTAX              DateAndTime
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "If trigger type is a time of action this object contains
the time."
                ::=  {  tmxFifoEntry  15  }


        tmxFifoOnDemand             OBJECT-TYPE
                SYNTAX          BITS { disabled(0), enabled(1)}
                MAX-ACCESS      read-create
                STATUS          current
                DESCRIPTION             "Switch for on-demand table generation"
                ::=  {  tmxFifoEntry  16  }


        tmxFifoStatus           OBJECT-TYPE
                SYNTAX              RowStatus
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Status of the row."
                ::=  {  tmxFifoEntry  17  }
*******************************************************************************
**
        tmxProgInsertTable          OBJECT-TYPE
                SYNTAX              SEQUENCE  OF  TmxProgInsertEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Table to control TMX's digital program insertion (Ads,
NVOD)
                         and splicing. Each row in this
                         table represents a create/delete Op command. All
                         Ops with the same Time of Action are to be executed
                         in the order specified by the message index."
                ::=  { tmxMediaControl  15 }

        tmxProgInsertEntry          OBJECT-TYPE
                SYNTAX              TmxProgInsertEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Entry"
                INDEX           { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex,
tmxProgInsertOpIndex }
                ::=  { tmxProgInsertTable 1 }

        TmxProgInsertEntry  ::=  SEQUENCE {
                tmxProgInsertOpIndex                Integer32,
                tmxProgInsertMsg            BITS,
                tmxProgInsertProgName               DisplayString,
                tmxProgInsertSplicerName    DisplayString,
                tmxProgInsertSplicerType    BITS,
                tmxProgInsertServerAddr     IpAddress,
```

```
            tmxProgInsertServerPort    Integer32,
            tmxProgInsertAdSrcId              Integer32,
            tmxProgInsertTmxAddr              IpAddress,
            tmxProgInsertTmxPort              Integer32,
            tmxProgInsertActionTrigger        ActionTriggerType,
            tmxProgInsertActionTime    DateAndTime,
            tmxProgInsertStatus               RowStatus
            }
*****************************************************************************
**

      tmxProgInsertOpIndex              OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          not-accessible
            STATUS              current
            DESCRIPTION
                  "This is used for unique identification and sequencing of
all
                   operational configuration messages. The value is the value
of
                   tmxOpNum when entry was created and is set by the manager."
            ::=  {  tmxProgInsertEntry  1  }


      tmxProgInsertMsg            OBJECT-TYPE
            SYNTAX              BITS  { create ( 0 ) , delete ( 1 ) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                  "Each table row constitutes a command message. The message
                   type indicates whether the Command type is to either create
                   or delete the item described in this row. Any create
command
                   is further restricted by the Action Trigger Type. Depending
on
                   the Action Trigger Type, the command will either be
immediately
                   executed, executed at a time specidfied by Time of Action,
or
                   executed when a SPliceImmediateFlag is raised."
            ::=  {  tmxProgInsertEntry 2  }


      tmxProgInsertProgName             OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "User assigned program name of the program being
spliced into."
            ::=  {  tmxProgInsertEntry  3  }


      tmxProgInsertSplicerName    OBJECT-TYPE
            SYNTAX              DisplayString
            MAX-ACCESS          read-create
            STATUS              current
```

```
            DESCRIPTION
                        "Name of the splicer if more then one in TMX (as in
DVS standard)."
            ::=  {  tmxProgInsertEntry  4  }

      tmxProgInsertSplicerType   OBJECT-TYPE
            SYNTAX              BITS  { adstreaminsert (0) , nvodstreaminsert
(1),
                                      actvstreaminsert(2) }
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Type of splicer."
            ::=  {  tmxProgInsertEntry  5  }


      tmxProgInsertServerAddr          OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "IP address of server for this stream insertion for
                         DVS 380 API."
            ::=  {  tmxProgInsertEntry  6  }


      tmxProgInsertServerPort          OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Server TCP port number for control of this stream
insertion
                         for DVS 380 API."
            ::=  {  tmxProgInsertEntry  7  }


      tmxProgInsertAdSrcId             OBJECT-TYPE
            SYNTAX              Integer32
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "Physical input identifier (ifIndex) of the ad/NVOD
stream."
            ::=  {  tmxProgInsertEntry  8  }


      tmxProgInsertTmxAddr             OBJECT-TYPE
            SYNTAX              IpAddress
            MAX-ACCESS          read-create
            STATUS              current
            DESCRIPTION
                        "IP address of TMX for this stream insertion for DVS
380 API."
            ::=  {  tmxProgInsertEntry  9  }
```

```
        tmxProgInsertTmxPort              OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                            "TMX TCP port number for control of this stream
insertion
                             for DVS 380 API."
                ::=  {  tmxProgInsertEntry  10  }


        tmxProgInsertActionTrigger OBJECT-TYPE
                SYNTAX              ActionTriggerType
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                            "Trigger type that will initiate this operation."
                ::=  {  tmxProgInsertEntry  11  }


        tmxProgInsertActionTime           OBJECT-TYPE
                SYNTAX              DateAndTime
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                      "If trigger type is a time of action this object contains
the time."
                ::=  {  tmxProgInsertEntry  12  }


        tmxProgInsertStatus         OBJECT-TYPE
                SYNTAX              RowStatus
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                            "Status of the row."
                ::=  {  tmxProgInsertEntry  13  }

-- tmxMediaMonitor tables enable monitoring of MPEG input/output information.
-- They consist of:
--              tmxInputPIDTable for input rate monitoring per PID
--              tmxOutputPIDTable for output rate monitoring per PID
--              tmxPsiSiTable for MPEG Table monitoring per PID
*****************************************************************************
**
        tmxInputPIDTable    OBJECT-TYPE
                SYNTAX              SEQUENCE  OF  TmxInputPIDEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                      "Table with input PID statistics."
                ::=  { tmxMediaMonitor  1 }

        tmxInputPIDEntry    OBJECT-TYPE
                SYNTAX              TmxInputPIDEntry
                MAX-ACCESS          not-accessible
                STATUS              current
```

```
            DESCRIPTION
                  "Entry"
            INDEX         {  ifIndex, tmxInputPIDId  }
            ::=  { tmxInputPIDTable 1 }

      TmxInputPIDEntry  ::=  SEQUENCE {
            tmxInputPIDId           Integer32,
            tmxInputPIDBitRate         Integer32,
            tmxInputPIDEntryStatus     RowStatus
            }
*****************************************************************************
**
      tmxInputPIDId           OBJECT-TYPE
            SYNTAX               Integer32
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
                        "Component PID with stream type."
            ::=  {  tmxInputPIDEntry  1  }


      tmxInputPIDBitRate         OBJECT-TYPE
            SYNTAX               Integer32
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
                        "Bit rate in bps."
            ::=  {  tmxInputPIDEntry  2  }

      tmxInputPIDEntryStatus           OBJECT-TYPE
            SYNTAX               RowStatus
            MAX-ACCESS           read-create
            STATUS               current
            DESCRIPTION
                        "Status of this entry."
            ::=  {  tmxInputPIDEntry  3  }
*****************************************************************************
**
      tmxOutputPIDTable          OBJECT-TYPE
            SYNTAX               SEQUENCE  OF  TmxOutputPIDEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION
                  "Table with output PID statistics."
            ::=  { tmxMediaMonitor  2 }

      tmxOutputPIDEntry          OBJECT-TYPE
            SYNTAX               TmxOutputPIDEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION
                  "Entry"
            INDEX         {  ifIndex, tmxOutputPIDId  }
            ::=  { tmxOutputPIDTable 1 }

      TmxOutputPIDEntry  ::=  SEQUENCE {
            tmxOutputPIDId                   Integer32,
```

```
            tmxOutputPIDBitRate                 Integer32,
            tmxOutputPIDMinBitRate              Integer32,
            tmxOutputPIDMaxBitRate              Integer32,
            tmxOutputPIDFrameRate               Integer32,
            tmxOutputPIDResolution              Integer32,
            tmxOutputPIDBFrames                 Integer32,
            tmxOutputPIDFilmMode                Integer32,
            tmxOutputPIDEntryStatus             RowStatus
            }
*******************************************************************************
**

      tmxOutputPIDId              OBJECT-TYPE
            SYNTAX                Integer32
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
                        "Component PID with stream type."
            ::=  {  tmxOutputPIDEntry  1  }


      tmxOutputPIDBitRate                 OBJECT-TYPE
            SYNTAX                Integer32
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
                        "Bit rate in bps."
            ::=  {  tmxOutputPIDEntry  2  }


      tmxOutputPIDMinBitRate              OBJECT-TYPE
            SYNTAX                Integer32
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
                        "Min Bit rate in bps."
            ::=  {  tmxOutputPIDEntry  3  }


      tmxOutputPIDMaxBitRate              OBJECT-TYPE
            SYNTAX                Integer32
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
                        "Max Bit rate in bps."
            ::=  {  tmxOutputPIDEntry  4  }


      tmxOutputPIDFrameRate               OBJECT-TYPE
            SYNTAX                Integer32
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
                        "Frame rate if the PID is a transcoded video PID."
            ::=  {  tmxOutputPIDEntry  5  }
```

```
        tmxOutputPIDResolution          OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-only
                STATUS              current
                DESCRIPTION
                        "Number of Macroblocks per Second if PID is a
transcoded video PID."
                ::=  {  tmxOutputPIDEntry  6  }


        tmxOutputPIDBFrames         OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-only
                STATUS              current
                DESCRIPTION
                        "Average ratio of B frames to I and P frames if PID
is a
                         transcoded video PID."
                ::=  {  tmxOutputPIDEntry  7  }


        tmxOutputPIDFilmMode            OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-only
                STATUS              current
                DESCRIPTION
                        "Film mode status if PID is a transcoded video PID."
                ::=  {  tmxOutputPIDEntry  8  }

        tmxOutputPIDEntryStatus         OBJECT-TYPE
                SYNTAX              RowStatus
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Status of this entry."
                ::=  {  tmxOutputPIDEntry  9  }

*****************************************************************************
**
        tmxPsiSiTable               OBJECT-TYPE
                SYNTAX              SEQUENCE  OF  TmxPsiSiEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Table of all input transport streams."
                ::=  { tmxMediaMonitor  3 }

        tmxPsiSiEntry OBJECT-TYPE
                SYNTAX              TmxPsiSiEntry
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Entry"
                INDEX           {  ifIndex, tmxPsiSiPidNum, tmxPsiSiTableId,
tmxPsiSiCurrNext}
                ::=  { tmxPsiSiTable        1 }
```

```
        TmxPsiSiEntry  ::=  SEQUENCE {
                tmxPsiSiPidNum              Integer32,
                tmxPsiSiTableId             Integer32,
                tmxPsiSiCurrNext            Integer32,
                tmxPsiSiTableInfo           OCTET STRING,
                tmxPsiSiVersion             Integer32,
                tmxPsiSiEntryStatus         RowStatus
                }
*****************************************************************************
**

        tmxPsiSiPidNum              OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Transport Stream PID number"
                ::=  {  tmxPsiSiEntry  1  }

        tmxPsiSiTableId             OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "Transport Stream Table Id"
                ::=  {  tmxPsiSiEntry  2  }

        tmxPsiSiCurrNext            OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          not-accessible
                STATUS              current
                DESCRIPTION
                        "MPEG Table currnet next indicator."
                ::=  {  tmxPsiSiEntry  3  }

        tmxPsiSiTableInfo           OBJECT-TYPE
                SYNTAX              OCTET STRING
                MAX-ACCESS          read-only
                STATUS              current
                DESCRIPTION
                        "Transport Stream Table."
                ::=  {  tmxPsiSiEntry  4  }

        tmxPsiSiVersion                     OBJECT-TYPE
                SYNTAX              Integer32
                MAX-ACCESS          read-only
                STATUS              current
                DESCRIPTION
                        "Table version for this transport stream"
                ::=  {  tmxPsiSiEntry  5  }

        tmxPsiSiEntryStatus         OBJECT-TYPE
                SYNTAX              RowStatus
                MAX-ACCESS          read-create
                STATUS              current
                DESCRIPTION
                        "Status of this entry."
```

```
            ::=  {  tmxPsiSiEntry  6  }

      tmxMuxMemoryTable          OBJECT-TYPE
            SYNTAX               SEQUENCE  OF  TmxMuxMemoryEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION
                  "Table indicating the maximum contiguous block of memory
available for carousels."
            ::=  { tmxMediaMonitor  4 }

      tmxMuxMemoryEntry          OBJECT-TYPE
            SYNTAX               TmxMuxMemoryEntry
            MAX-ACCESS           not-accessible
            STATUS               current
            DESCRIPTION
                  "Entry"
            INDEX          {ifIndex}
            ::=  { tmxMuxMemoryTable   1 }

      TmxMuxMemoryEntry  ::=  SEQUENCE {
            tmxMuxMemorySize           Integer32,
            tmxMuxMemoryEntryStatus    RowStatus
            }


      tmxMuxMemorySize           OBJECT-TYPE
            SYNTAX               Integer32
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
                        "The maximum byte size currently available."
            ::=  {  tmxMuxMemoryEntry  1  }

      tmxMuxMemoryEntryStatus          OBJECT-TYPE
            SYNTAX               RowStatus
            MAX-ACCESS           read-create
            STATUS               current
            DESCRIPTION
                        "Status of this entry."
            ::=  {  tmxMuxMemoryEntry  2  }

END
```

[0077] While the present invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but is intended to encompass the various modifications and equivalent arrangements included within the spirit and scope of the appended claims. With respect to the above description, for example, it is to be realized that the optimum implementation, function and manner of operation, assembly and use, are deemed readily apparent to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the appended claims. Therefore, the foregoing is considered to be an illustrative, not exhaustive, description of the principles of the present invention.

What is claimed is:

1. A control system that uses SNMP to remotely control broadband communications hardware via a network, the communications hardware comprising a plurality of processor boards that perform content stream manipulation and configuration task firmware for configuring and controlling the processor boards, the control system comprising:

a user interface for presenting information to a control system operator and for receiving input from the operator;

an element manager communicatively linking the user interface to the network, the element manager packaging the operator input as SNMP messages and sending the messages to the SNMP agent via the network, the element manager also receiving SNMP messages from the SNMP agent via the network and providing information contained therein to the user interface for presentation to the operator; and

an SNMP agent communicatively linking the configuration task firmware and the network, the SNMP agent comprising means for brokering information exchanged between the element manager and the configuration task firmware.

2. The control system of claim 1 wherein the SNMP agent translates SNMP messages received from the element manager via the network into a form that can be understood by the configuration task firmware and packages information in to SNMP messages for receipt by the element manager via the network.

3. The control system of claim 1 wherein the content streams are MPEG 2 data streams, wherein the network is an Ethernet network and wherein the communications hardware is a TMX chassis.

4. The control system of claim 1 wherein the user interface is a graphical user interface comprising a common browser.

5. The control system of claim 1 wherein the SNMP agent populates MIB tables with system data received from the configuration task firmware and wherein the element manager reads the system data from the MIB tables and provides it to the user interface for display.

6. The control system of claim 1 wherein the element manager populates MIB tables with operator input received from the user interface and wherein the SNMP agent reads the operator input from the MIB tables and provides it as instructions to the configuration task firmware.

7. The control system of claim 1 wherein the element manager runs on a personal computer that is communicatively linked to the network and wherein the element manager has been uploaded to the computer as a java applet via the network during a set-up phase.

8. A method of remotely controlling broadband communications hardware via a network, the communications hardware comprising a plurality of processor boards for manipulating content streams and configuration task firmware for configuring and controlling the processor boards, the method comprising:

receiving content stream control commands from the operator at a first location on the network;

packaging the control commands as SNMP messages;

sending the SNMP messages across the network to a second location physically remote from the first location;

receiving the SNMP messages at the second location;

translating the received SNMP messages into control commands that the configuration task firmware can understand; and

sending the translated commands to the configuration task firmware for execution.

9. The method of claim 8 wherein the content streams are MPEG 2 data streams, wherein the network is an Ethernet network and wherein the communications hardware is a TMX chassis.

10. The method of claim 8 wherein receiving content stream control commands comprises receiving content stream drag and drop commands from a graphical user interface that comprises a browser.

11. The method of claim 10 wherein packaging the control commands as SNMP messages comprises populating MIB tables with content stream attributes resulting from the drag and drop commands.

12. The method of claim 10 further comprising

polling the communications hardware for system status data;

populating MIB tables with the system status data;

reading the system status data from the MIB tables; and

displaying the system status data on the graphical user interface.

13. The method of claim 10 further comprising

polling the communications hardware for content stream attribute data;

populating MIB tables with the content stream attribute data;

reading the content stream attribute data from the MIB tables; and

displaying the system content stream data on the graphical user interface.

14. The method of claim 10 further comprising

polling the communications processor board attribute data comprising data relating to the identity, structure and operational status of the processor boards;

populating MIB tables with the processor board attribute data;

reading the processor board attribute data from the MIB tables; and

displaying the processor board attribute data on the graphical user interface.

15. A method of remotely enabling an output port of a TMX chassis via a network, the TMX chassis having a multiplexer, a quantization level processor and an input processor for manipulating content streams passing therethrough to the output port, the method comprising:

receiving a port enable command from an operator at a first location on the network;

sending the port enable command across the network to the TMX chassis at a second location physically remote from the first location; and

responsive to receipt of the port enable command,

activating the targeted multiplexer first,

activating the quantization level processor second; and

activating the input processor third to thereby permit a content stream to pass to the output port.

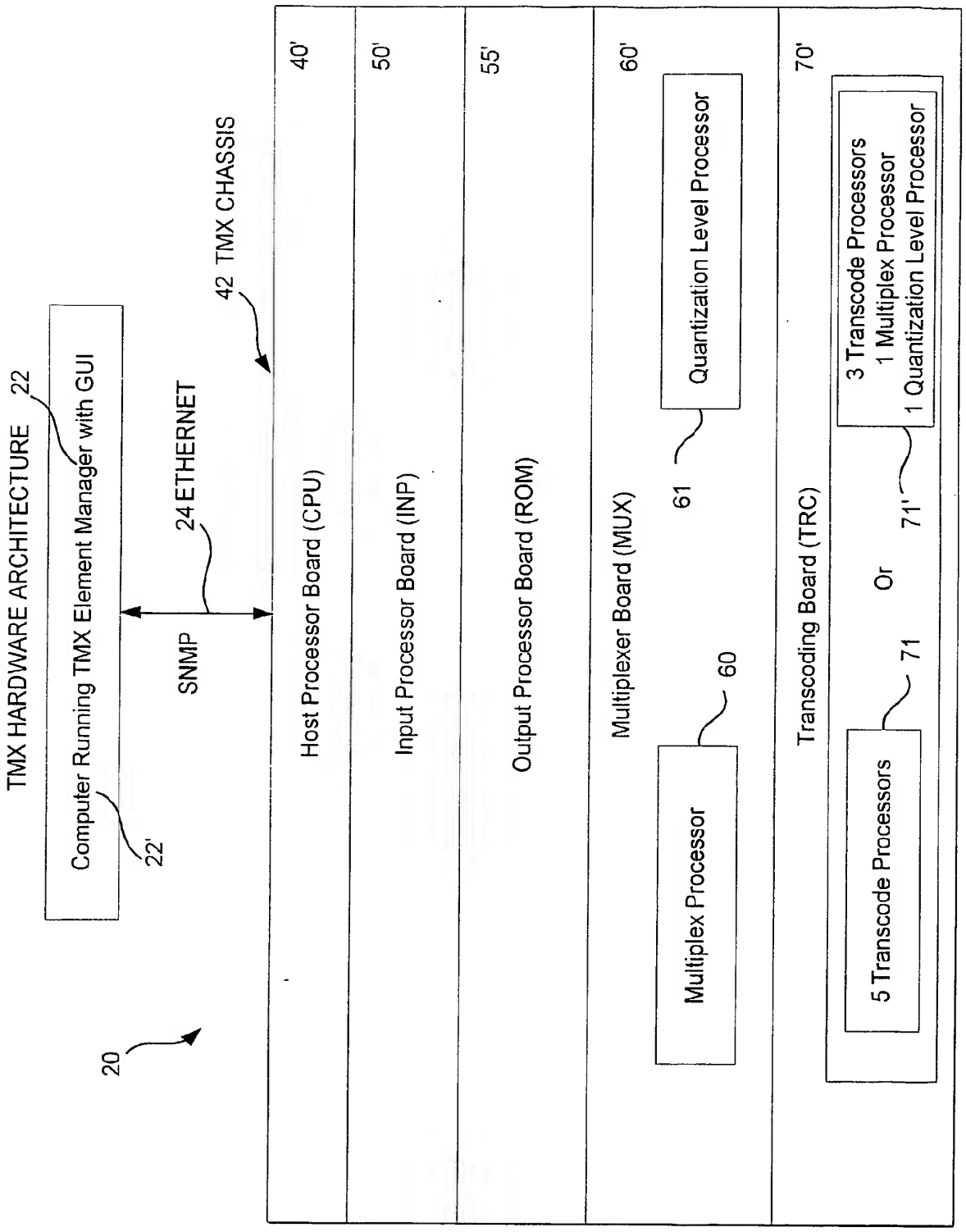

TMX HARDWARE ARCHITECTURE
22
Computer Running TMX Element Manager with GUI
22'
20
SNMP
24 ETHERNET
42 TMX CHASSIS
Host Processor Board (CPU)
40'
Input Processor Board (INP)
50'
Output Processor Board (ROM)
55'
Multiplexer Board (MUX)
60'
Multiplex Processor
60
Quantization Level Processor
61
Transcoding Board (TRC)
70'
5 Transcode Processors
71
Or
3 Transcode Processors
1 Multiplex Processor
1 Quantization Level Processor
71'

Figure 1a

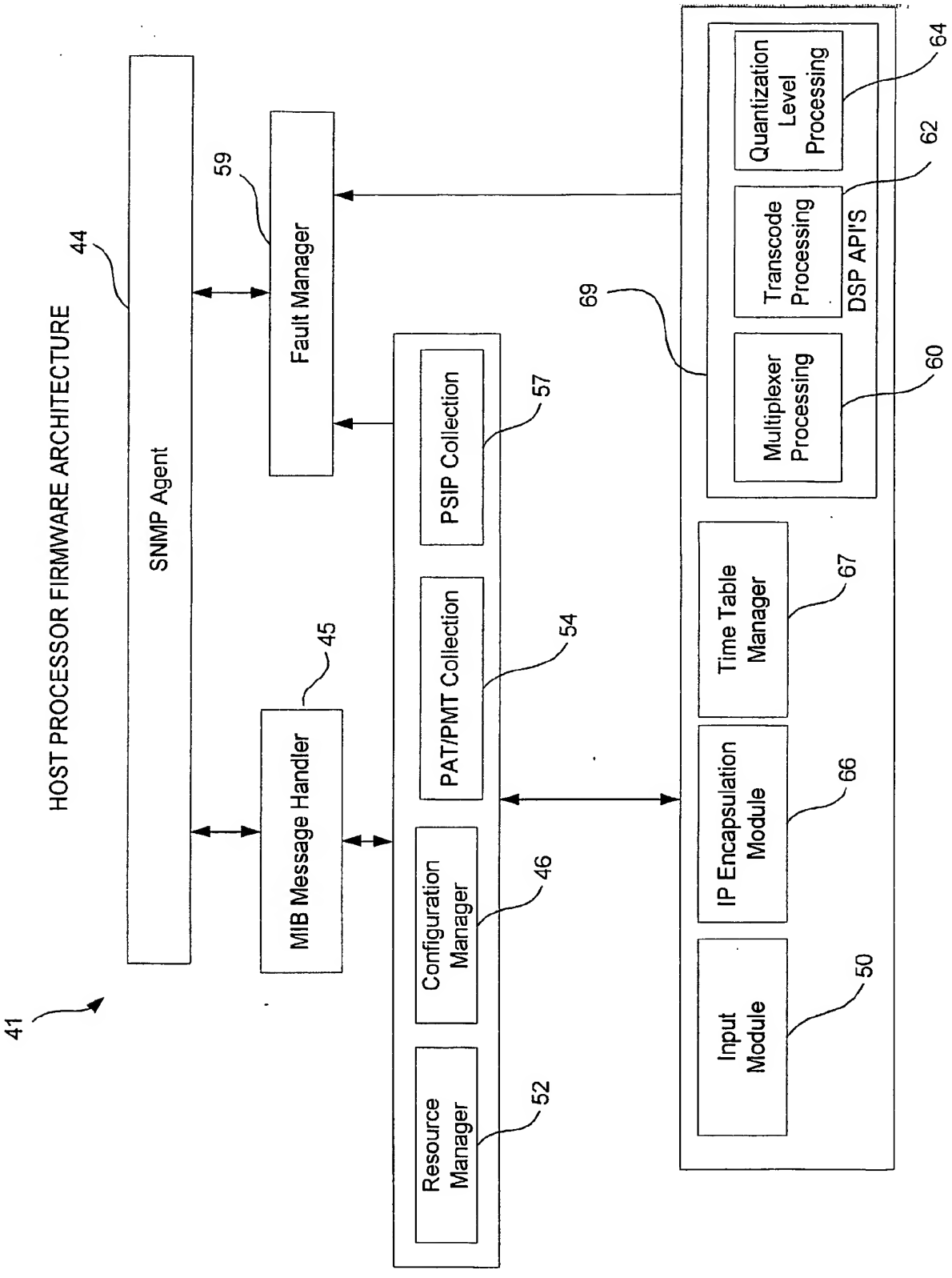

HOST PROCESSOR FIRMWARE ARCHITECTURE
41
SNMP Agent
44
Fault Manager
59
MIB Message Handler
45
Resource Manager
52
Configuration Manager
46
PAT/PMT Collection
54
PSIP Collection
57
Input Module
50
IP Encapsulation Module
66
Time Table Manager
67
Multiplexer Processing
60
Transcode Processing
62
Quantization Level Processing
64
DSP API'S
69

Figure 1b

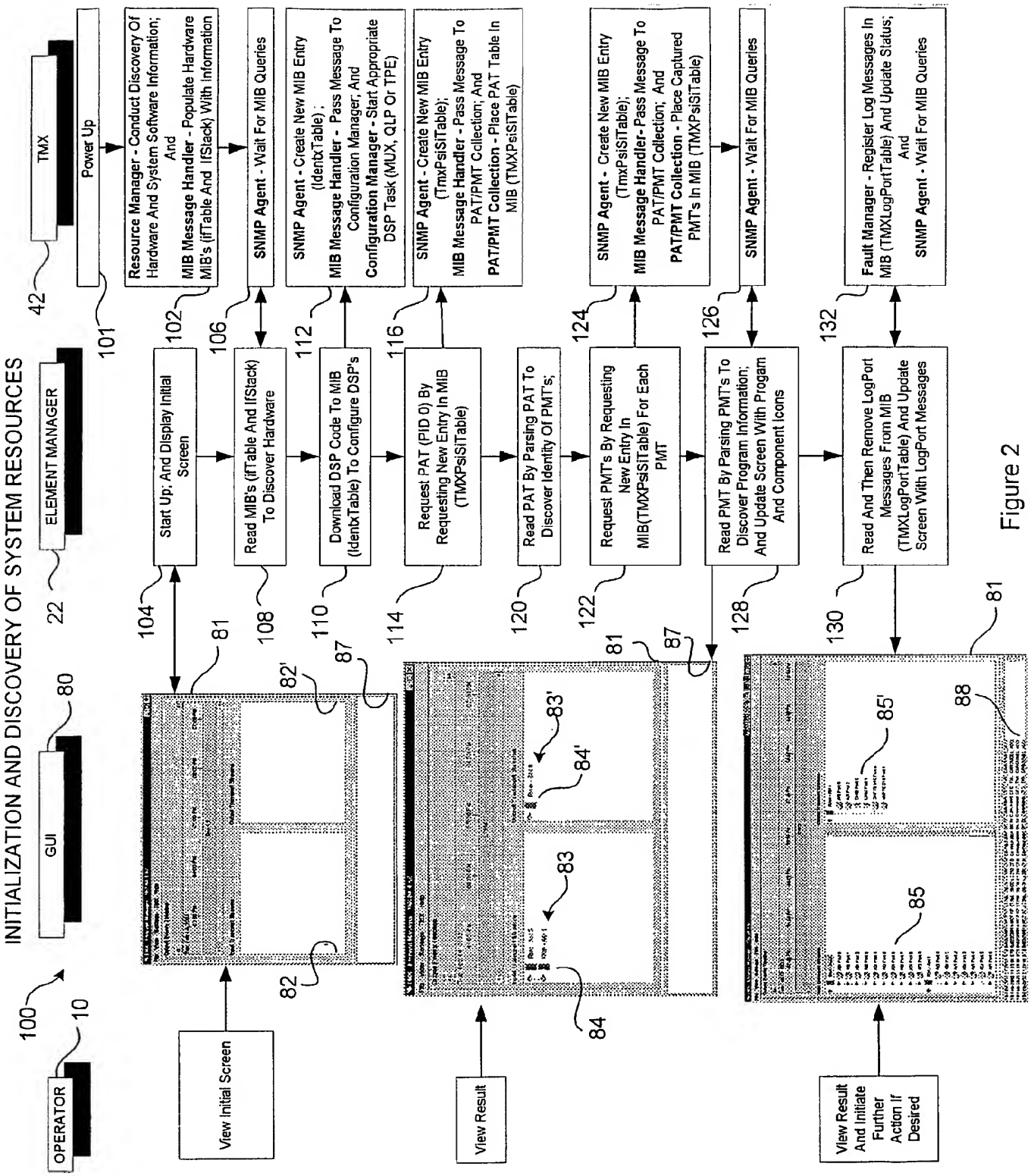

INITIALIZATION AND DISCOVERY OF SYSTEM RESOURCES
OPERATOR
GUI
ELEMENT MANAGER
TMX
Power Up
Resource Manager - Conduct Discovery Of Hardware And System Software Information; And
MIB Message Handler - Populate Hardware MIB's (ifTable And IfStack) With Information
SNMP Agent - Wait For MIB Queries
SNMP Agent - Create New MIB Entry (IdentxTable);
MIB Message Handler - Pass Message To Configuration Manager; And
Configuration Manager - Start Appropriate DSP Task (MUX, QLP Or TPE)
SNMP Agent - Create New MIB Entry (TmxPsiSiTable);
MIB Message Handler - Pass Message To PAT/PMT Collection; And
PAT/PMT Collection - Place PAT Table In MIB (TMXPsiSiTable)
SNMP Agent - Create New MIB Entry (TmxPsiSiTable);
MIB Message Handler - Pass Message To PAT/PMT Collection; And
PAT/PMT Collection - Place Captured PMT's In MIB (TMXPsiSiTable)
SNMP Agent - Wait For MIB Queries
Fault Manager - Register Log Messages In MIB (TMXLogPortTable) And Update Status; And
SNMP Agent - Wait For MIB Queries
Start Up; And Display Initial Screen
Read MIB's (ifTable And IfStack) To Discover Hardware
Download DSP Code To MIB (IdentxTable) To Configure DSP's
Request PAT (PID 0) By Requesting New Entry In MIB (TMXPsiSiTable)
Read PAT By Parsing PAT To Discover Identity Of PMT's;
Request PMTs By Requesting New Entry In MIB(TMXPsiSiTable) For Each PMT
Read PMT By Parsing PMT's To Discover Program Information; And Update Screen With Progam And Component Icons
Read And Then Remove LogPort Messages From MIB (TMXLogPortTable) And Update Screen With LogPort Messages
View Initial Screen
View Result
View Result And Initiate Further Action If Desired
100
10
22
42
80
81
82
82'
83
83'
84
84'
85
85'
87
88
101
102
104
106
108
110
112
114
116
120
122
124
126
128
130
132

Figure 2

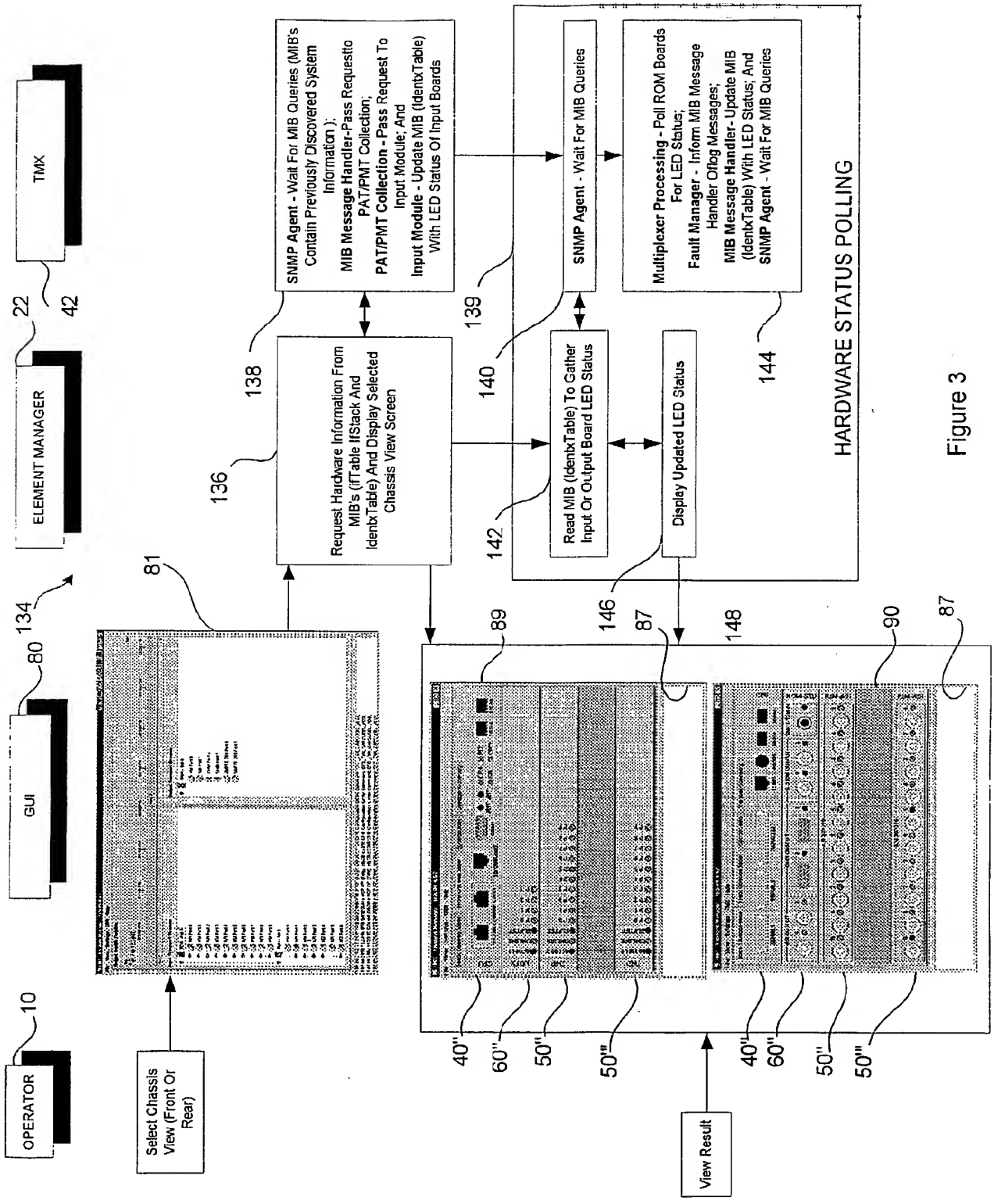

VIEW SYSTEM HARDWARE ATTRIBUTES
TMX
42
ELEMENT MANAGER
22
GUI
80
134
OPERATOR
10
81
Select Chassis View (Front Or Rear)
View Result
136
Request Hardware Information From MIB's (ifTable IfStack And IdentxTable) And Display Selected Chassis View Screen
138
SNMP Agent - Wait For MIB Queries (MIB's Contain Previously Discovered System Information):
MIB Message Handler-Pass Requestto PAT/PMT Collection;
PAT/PMT Collection - Pass Request To Input Module; And
Input Module - Update MIB (IdentxTable) With LED Status Of Input Boards
139
140
SNMP Agent - Wait For MIB Queries
142
Read MIB (IdentxTable) To Gather Input Or Output Board LED Status
144
Multiplexer Processing - Poll ROM Boards For LED Status;
Fault Manager - Inform MIB Message Handler Oflog Messages;
MIB Message Handler - Update MIB (IdentxTable) With LED Status; And
SNMP Agent - Wait For MIB Queries
146
Display Updated LED Status
148
HARDWARE STATUS POLLING
87
89
90
40"
60"
50"
50"
40"
60"
50"
50"

Figure 3

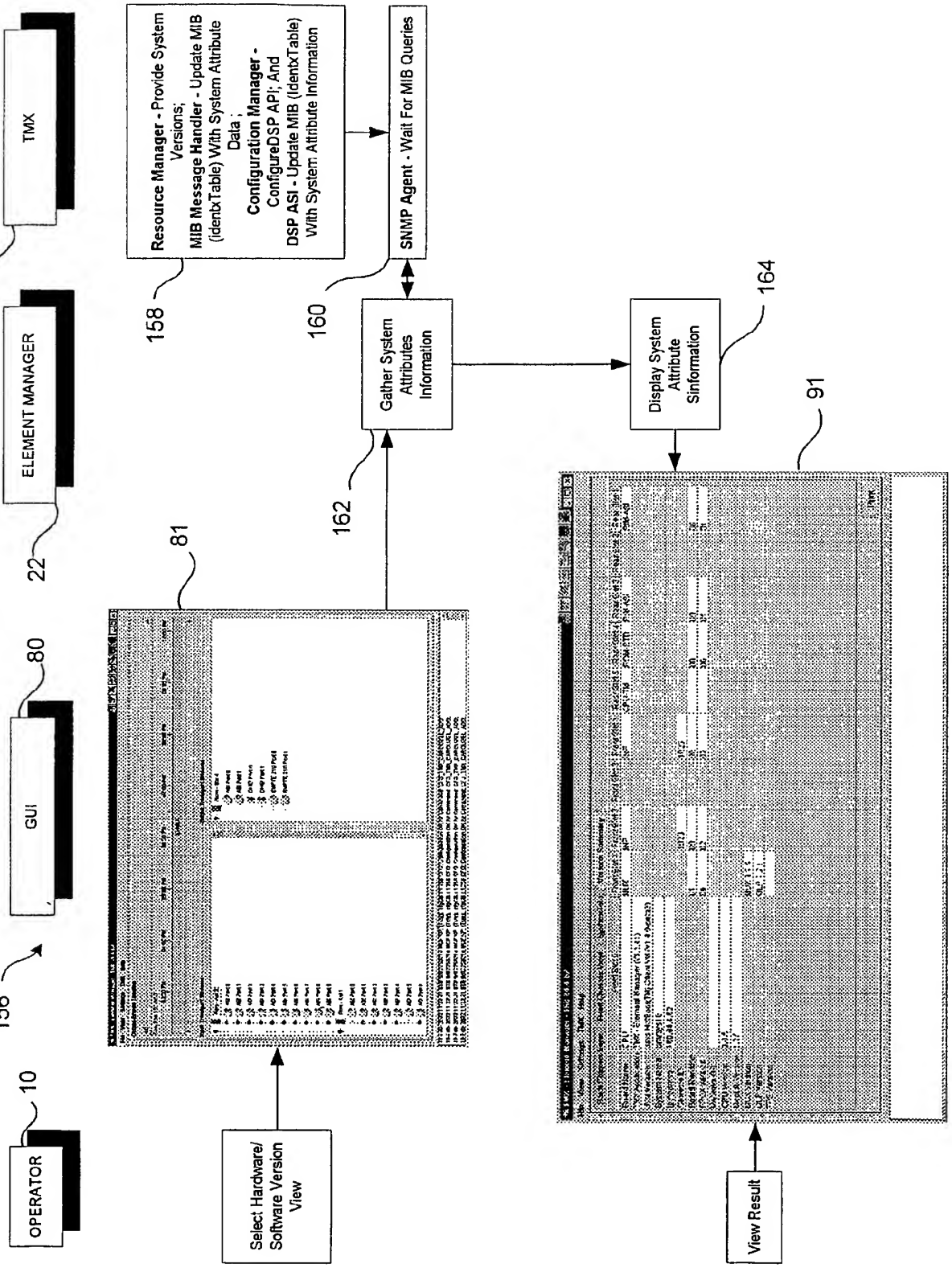

VIEW SYSTEM ATTRIBUTES
TMX
42
ELEMENT MANAGER
22
GUI
80
156
OPERATOR
10
Select Hardware/ Software Version View
81
158
Resource Manager - Provide System Versions;
MIB Message Handler - Update MIB (identxTable) With System Attribute Data ;
Configuration Manager - ConfigureDSP API; And
DSP ASI - Update MIB (IdentxTable) With System Attribute Information
160
SNMP Agent - Wait For MIB Queries
162
Gather System Attributes Information
164
Display System Attribute Sinformation
91
View Result

Figure 4

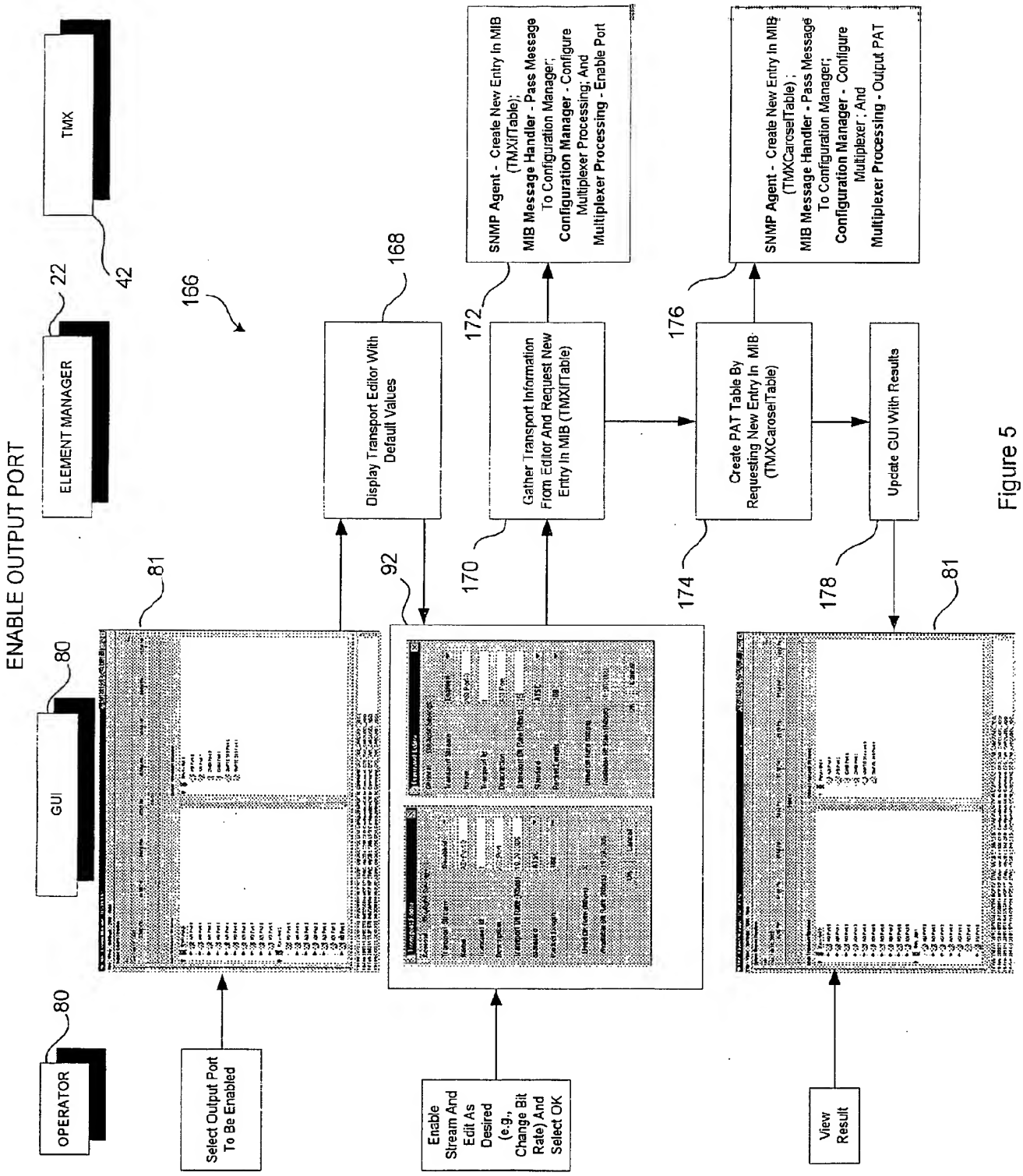

ENABLE OUTPUT PORT
TMX
42
ELEMENT MANAGER
22
166
168
Display Transport Editor With Default Values
SNMP Agent - Create New Entry In MIB (TMXifTable);
MIB Message Handler - Pass Message To Configuration Manager;
Configuration Manager - Configure Multiplexer Processing; And
Multiplexer Processing - Enable Port
172
Gather Transport Information From Editor And Request New Entry In MIB (TMXifTable)
170
176
Create PAT Table By Requesting New Entry In MIB (TMXCarcoselTable)
SNMP Agent - Create New Entry In MIB (TMXCarcoselTable);
MIB Message Handler - Pass Message To Configuration Manager;
Configuration Manager - Configure Multiplexer ; And
Multiplexer Processing - Output PAT
174
178
Update GUI With Results
81
92
81
GUI
80
OPERATOR
80
Select Output Port To Be Enabled
Enable Stream And Edit As Desired (e.g., Change Bit Rate) And Select OK
View Result

Figure 5

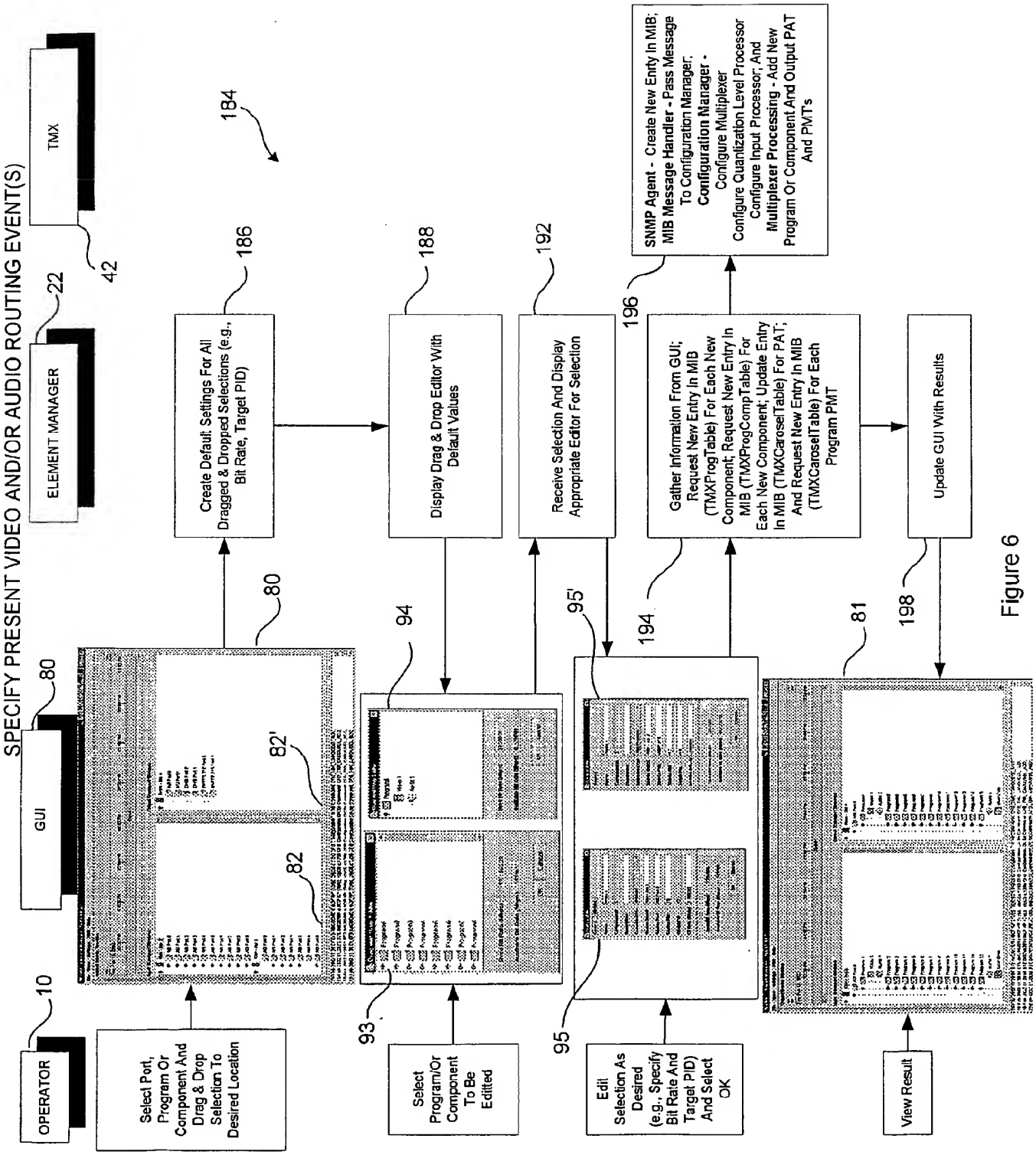
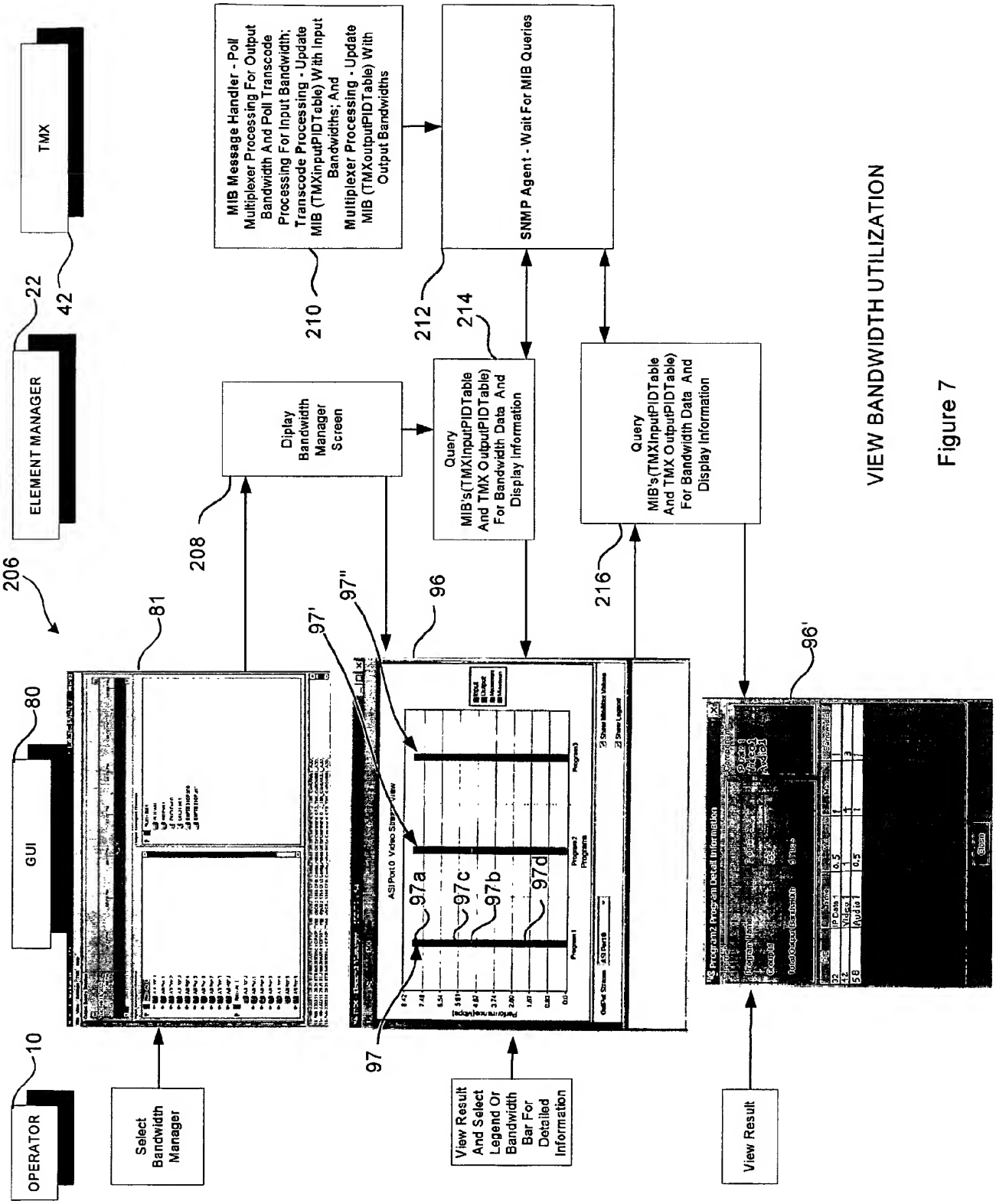

SPECIFY PRESENT VIDEO AND/OR AUDIO ROUTING EVENT(S)
TMX
42
ELEMENT MANAGER
22
184
186
Create Default Settings For All Dragged & Dropped Selections (e.g., Bit Rate, Target PID)
188
Display Drag & Drop Editor With Default Values
192
Receive Selection And Display Appropriate Editor For Selection
196
SNMP Agent - Create New Entry In MIB; MIB Message Handler - Pass Message To Configuration Manager; Configuration Manager - Configure Multiplexer Configure Quantization Level Processor Configure Input Processor; And Multiplexer Processing - Add New Program Or Component And Output PAT And PMTs
Gather Information From GUI; Request New Entry In MIB (TMXProgTable) For Each New Component; Request New Entry In MIB (TMXProgCompTable) For Each New Component; Update Entry In MIB (TMXCaroselTable) For PAT; And Request New Entry In MIB (TMXCaroselTable) For Each Program PMT
194
Update GUI With Results
198
80
GUI
80
82'
82
94
95'
81
10
OPERATOR
Select Port, Program Or Component And Drag & Drop Selection To Desired Location
93
Select Program/Or Component To Be Edited
95
Edit Selection As Desired (e.g., Specify Bit Rate And Target PID) And Select OK
View Result

Figure 6



VIEW BANDWIDTH UTILIZATION

Figure 7

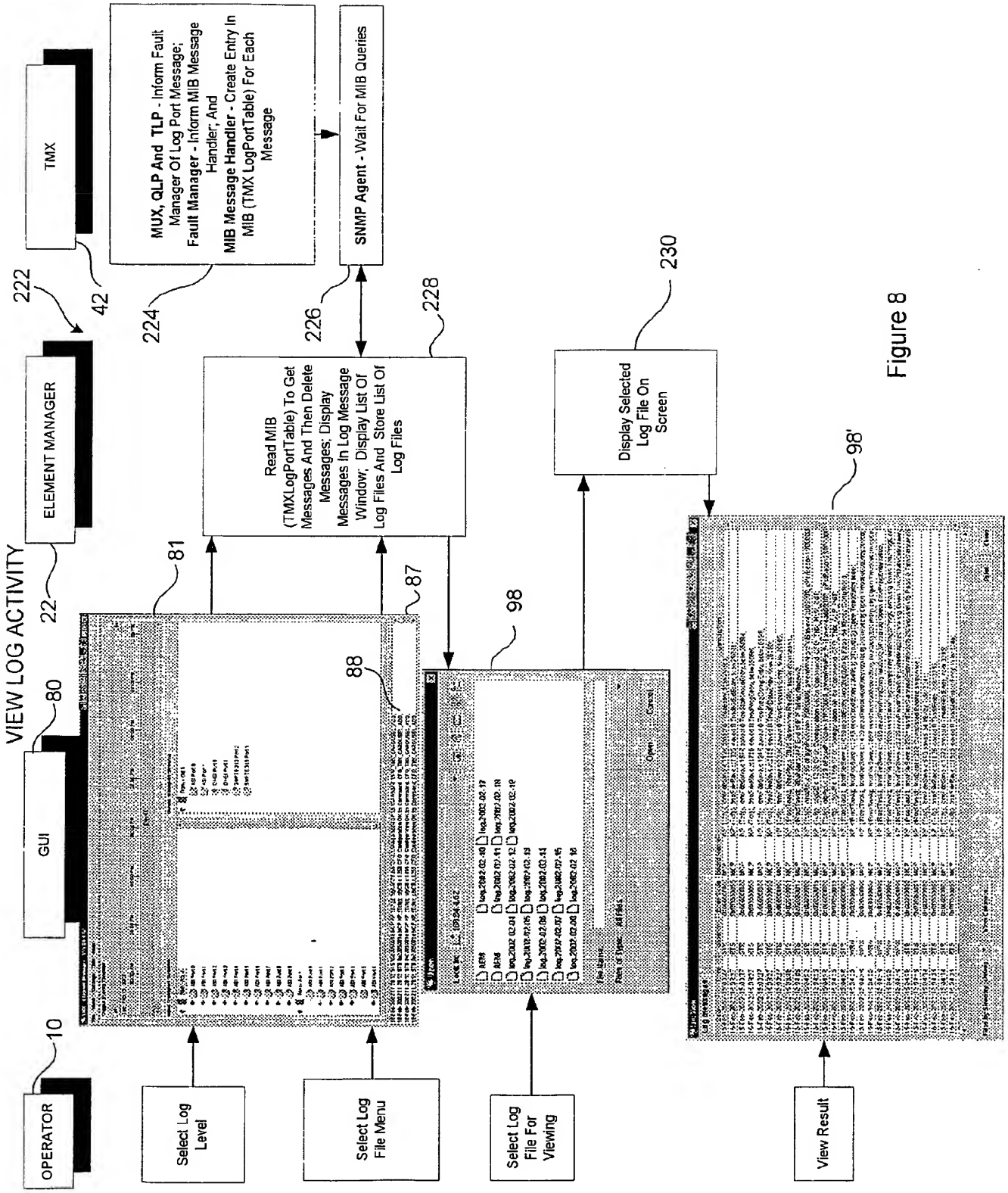

VIEW LOG ACTIVITY
OPERATOR
10
GUI
80
ELEMENT MANAGER
22
TMX
42
222
MUX, QLP And TLP - Inform Fault Manager Of Log Port Message; Fault Manager - Inform MIB Message Handler; And MIB Message Handler - Create Entry In MIB (TMX LogPortTable) For Each Message
224
SNMP Agent - Wait For MIB Queries
226
Read MIB (TMXLogPortTable) To Get Messages And Then Delete Messages; Display Messages In Log Message Window; Display List Of Log Files And Store List Of Log Files
228
Display Selected Log File On Screen
230
81
87
88
98
98'
Select Log Level
Select Log File Menu
Select Log File For Viewing
View Result

Figure 8

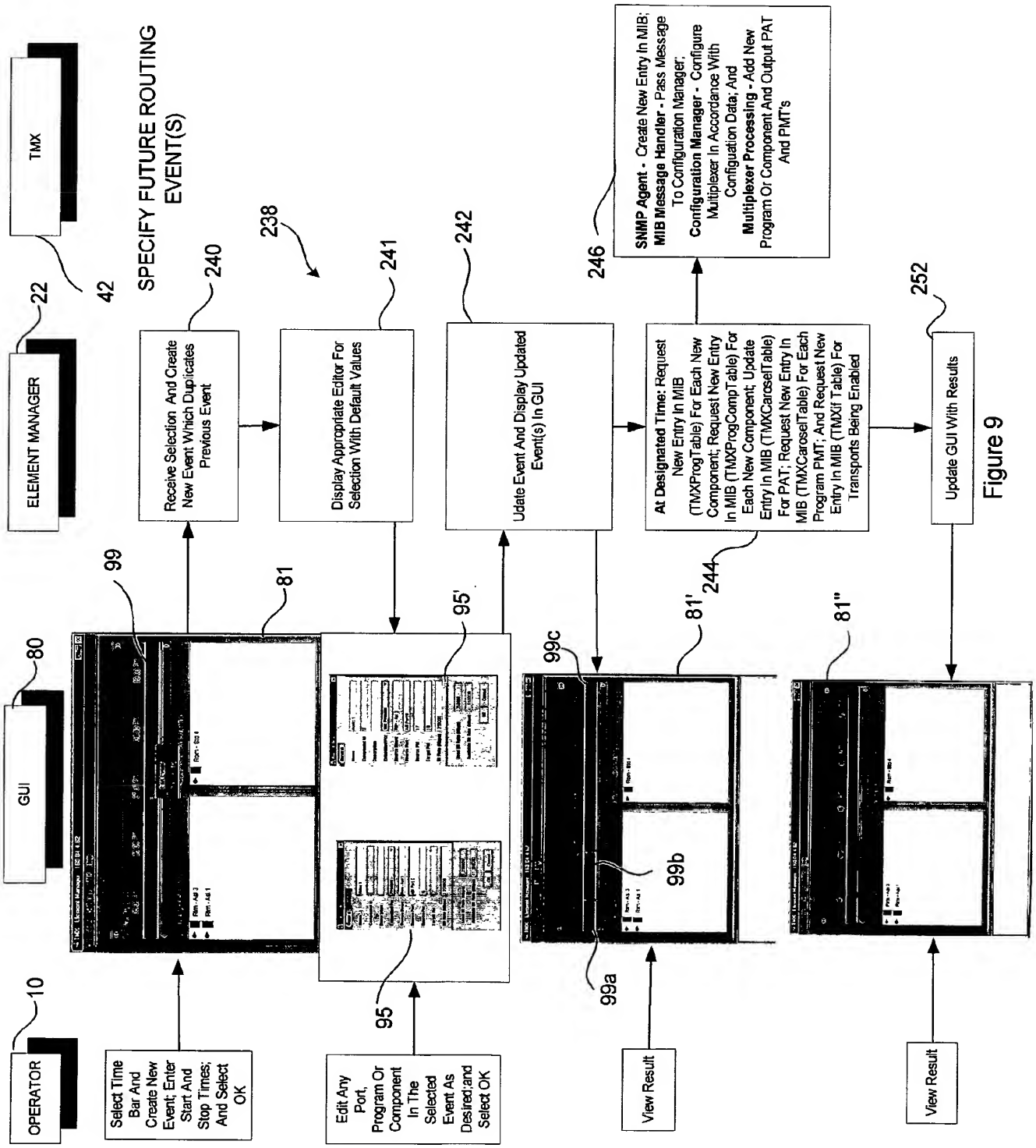

SPECIFY FUTURE ROUTING EVENT(S)
238
240
241
242
246
252
TMX
42
ELEMENT MANAGER
22
GUI
80
OPERATOR
10
99
81
95'
95
99c
99b
99a
81'
81"
244
Receive Selection And Create New Event Which Duplicates Previous Event
Display Appropriate Editor For Selection With Default Values
Udate Event And Display Updated Event(s) In GUI
At Designated Time: Request New Entry In MIB (TMXProgTable) For Each New Component; Request New Entry In MIB (TMXProgCompTable) For Each New Component; Update Entry In MIB (TMXCaroselTable) For PAT; Request New Entry In MIB (TMXCaroselTable) For Each Program PMT; And Request New Entry In MIB (TMXif Table) For Transports Being Enabled
SNMP Agent - Create New Entry In MIB; MIB Message Handler - Pass Message To Configuration Manager; Configuration Manager - Configure Multiplexer In Accordance With Configuation Data; And Multiplexer Processing - Add New Program Or Component And Output PAT And PMT's
Update GUI With Results
Select Time Bar And Create New Event; Enter Start And Stop Times; And Select OK
Edit Any Port, Program Or Component In The Selected Event As Desired;and Select OK
View Result
View Result

Figure 9

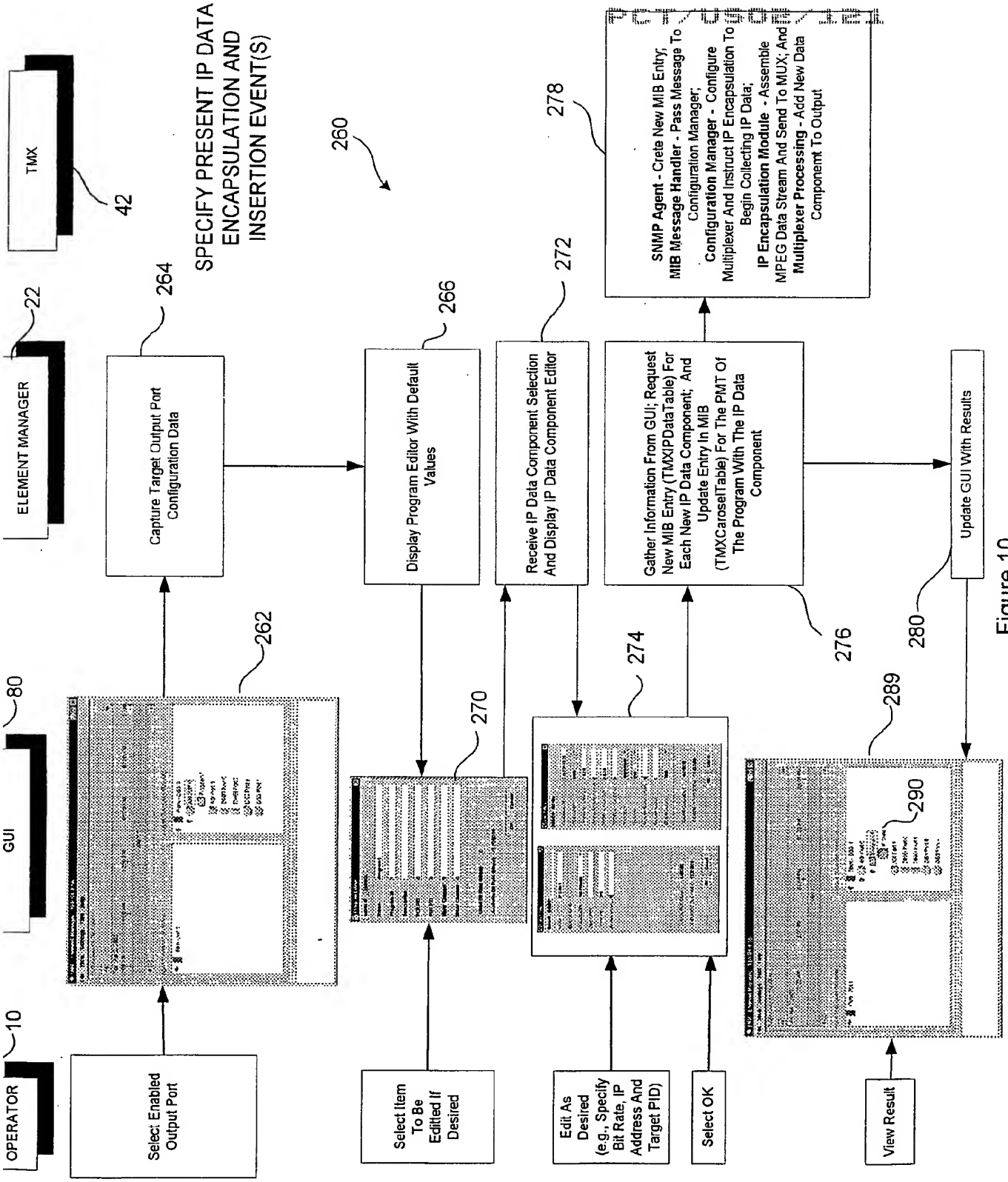

SPECIFY PRESENT IP DATA ENCAPSULATION AND INSERTION EVENT(S)
260
TMX
42
ELEMENT MANAGER
22
OPERATOR
10
GUI
80
Select Enabled Output Port
262
Capture Target Output Port Configuration Data
264
Display Program Editor With Default Values
266
270
Select Item To Be Edited If Desired
Receive IP Data Component Selection And Display IP Data Component Editor
272
274
Edit As Desired (e.g., Specify Bit Rate, IP Address And Target PID)
Select OK
Gather Information From GUI; Request New MIB Entry (TMXIPDataTable) For Each New IP Data Component; And Update Entry In MIB (TMXCarouselTable) For The PMT Of The Program With The IP Data Component
276
SNMP Agent - Crete New MIB Entry;
MIB Message Handler - Pass Message To Configuration Manager;
Configuration Manager - Configure Multiplexer And Instruct IP Encapsulation To Begin Collecting IP Data;
IP Encapsulation Module - Assemble MPEG Data Stream And Send To MUX; And
Multiplexer Processing - Add New Data Component To Output
278
Update GUI With Results
280
289
290
View Result

Figure 10

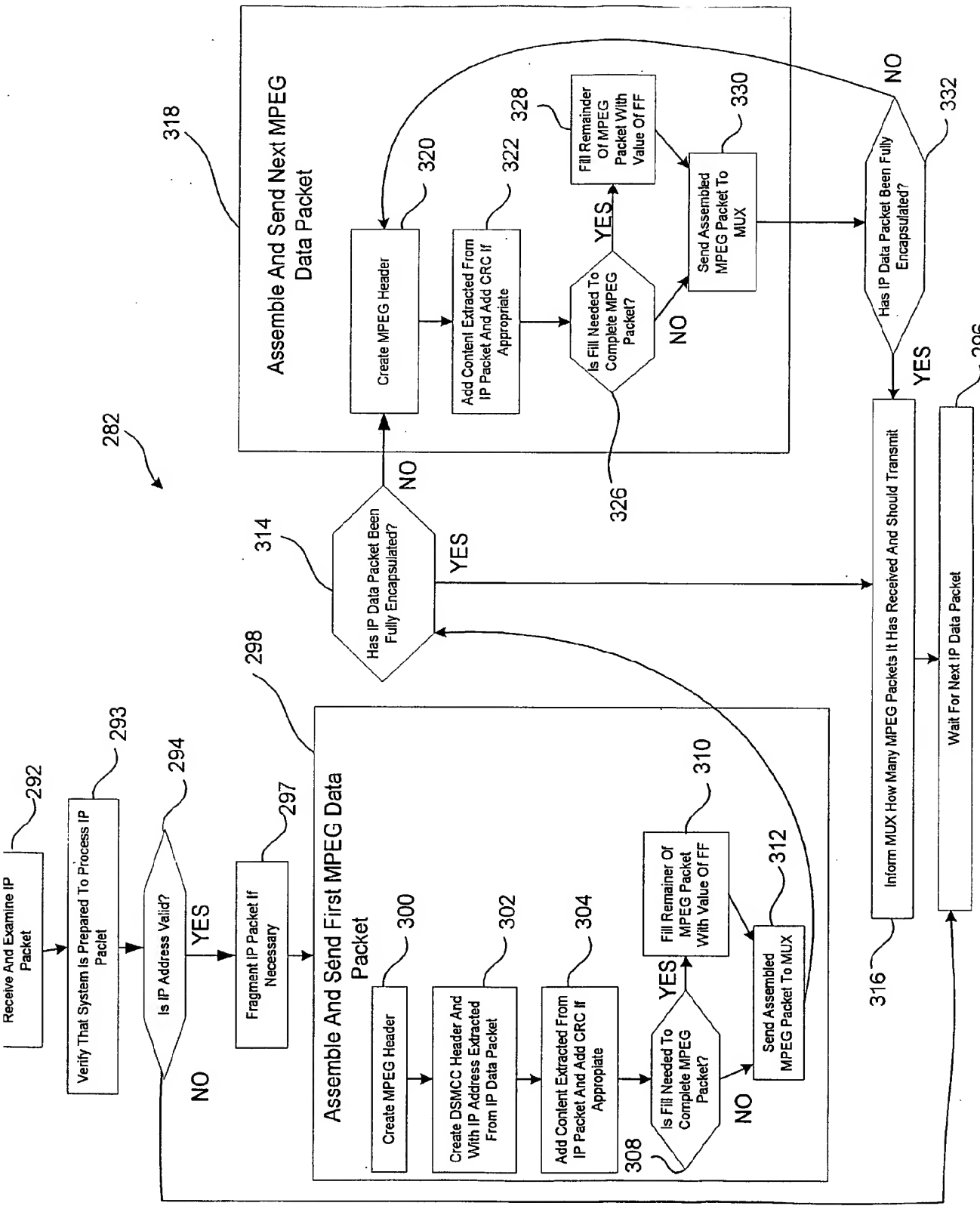

Receive And Examine IP Packet
292
Verify That System Is Prepared To Process IP Packet
293
Is IP Address Valid?
294
YES
NO
Fragment IP Packet If Necessary
297
Assemble And Send First MPEG Data Packet
298
Create MPEG Header
300
Create DSMCC Header And With IP Address Extracted From IP Data Packet
302
Add Content Extracted From IP Packet And Add CRC If Appropiate
304
Is Fill Needed To Complete MPEG Packet?
308
YES
NO
Fill Remainer Of MPEG Packet With Value Of FF
310
Send Assembled MPEG Packet To MUX
312
Has IP Data Packet Been Fully Encapsulated?
314
YES
NO
Assemble And Send Next MPEG Data Packet
318
Create MPEG Header
320
Add Content Extracted From IP Packet And Add CRC If Appropriate
322
Is Fill Needed To Complete MPEG Packet?
326
YES
NO
Fill Remainder Of MPEG Packet With Value Of FF
328
Send Assembled MPEG Packet To MUX
330
Has IP Data Packet Been Fully Encapsulated?
332
NO
YES
Inform MUX How Many MPEG Packets It Has Received And Should Transmit
316
Wait For Next IP Data Packet
296
282

Figure 11